DATA WAREHOUSING AND DATA MINING LAB (R20A1283)

LAB MANUAL

B.TECH
(III YEAR – II SEM)
(2023-24)

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DEPARTMENT OF INFORMATION TECHNOLOGY

MALLA REDDY COLLEGE OF ENGINEERING&TECHNOLOGY
(Autonomous Institution – UGC, Govt. of India)
Recognized under 2(f) and 12 (B) of UGC ACT 1956
Affiliated to JNTUH, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2008 Certified)
Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad – 500100, Telangana State, India

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION

- To achieve high quality education in technical education that provides the skills and attitude to adapt to the global needs of the Information technologysector, through academic and research excellence.

MISSION

- To equip the students with the cognizance for problem solving and to improve the teaching learning pedagogy by using innovative techniques.
- To strengthen the knowledge base of the faculty and students with the motivation towards possession of effective academic skills and relevant research experience.
- To promote the necessary moral and ethical values among the engineers for the betterment of the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – PROFESSIONALISM &CITIZENSHIP

To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues.

PEO2 – TECHNICAL ACCOMPLISHMENTS

To provide knowledge based services to satisfy the needs of society and the industry by providing hands on experience in various technologies in core field.

PEO3 – INVENTION, INNOVATION AND CREATIVITY

To make the students to design, experiment, analyze, interpret in the core field with the help of other multi-disciplinary concepts wherever applicable.

PEO4 – PROFESSIONAL ETHICS

To educate the students to disseminate research findings with good soft skills and become a successful entrepreneur.

PEO5 – HUMAN RESOURCE DEVELOPMENT

To graduate the students in building national capabilities in technology, education and research.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After the completion of the course, B. Tech Information Technology, thegraduates will have the following Program Specific Outcomes:

1. **Fundamentals and critical knowledge of the Computer System:-** Able to Understand the working principles of the computer System and its components , Apply the knowledge to build, asses, and analyze the software and hardware aspects of it .

2. **The comprehensive and Applicative knowledge of Software Development:** Comprehensive skills of Programming Languages, Software process models, methodologies, and able to plan, develop, test, analyze, and manage the software and hardware intensive systems in heterogeneous platforms individually or working in teams.

3. **Applications of Computing Domain & Research:** Able to use the professional, managerial, interdisciplinary skill set, and domain specific tools in development processes, identify the research gaps, and provide innovative solutions to them.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance** : Demonstrate knowledge and understandingof the engineering and management principles and apply these to one's own work, asa member and leader in a team, to manage projects and in multi disciplinary environments.
12. **Life- long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY
Maisammaguda, Dhulapally Post, Via Hakimpet, Secunderabad – 500100

DEPARTMENT OF INFORMATION TECHNOLOGY

GENERAL LABORATORY INSTRUCTIONS

1. Students are advised to come to the laboratory at least 5 minutes before (to the starting time), those who come after 5 minutes will not be allowed into the lab.
2. Plan your task properly much before to the commencement, come prepared to the lab with the synopsis / program / experiment details.
3. Student should enter into the laboratory with:

a. Laboratory observation notes with all the details (Problem statement, Aim, Algorithm, Procedure, Program, Expected Output, etc.,) filled in for the lab session.
b. Laboratory Record updated up to the last session experiments and other utensils (if any) neededin the lab.
c. Proper Dress code and Identity card.

4. Sign in the laboratory login register, write the TIME-IN, and occupy the computer system allotted to you bythe faculty.
5. Execute your task in the laboratory, and record the results / output in the lab observation note book, and get certified by the concerned faculty.
6. All the students should be polite and cooperative with the laboratory staff, must maintain the discipline and decency in the laboratory.
7. Computer labs are established with sophisticated and high-end branded systems, which should be utilized properly.
8. Students / Faculty must keep their mobile phones in SWITCHED OFF mode during the lab sessions. Misuse of the equipment, misbehaviors with the staff and systems etc., will attract severe punishment.
9. Students must take the permission of the faculty in case of any urgency to go out; if anybody found loitering outside the lab / class without permission during working hours will be treated seriously and punished appropriately.
10. Students should LOG OFF/ SHUT DOWN the computer system before he/she leaves the lab after completing the task (experiment) in all aspects. He/she must ensure the system / seat is kept properly.

HEAD OF THE DEPARTMENT **PRINCIPAL**

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

B.TECH - III- YEAR II-SEM-IT **L/T/P/C**

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(R20A1283)DATA WAREHOUSING AND DATA MINING

COURSE OBJECTIVES:

1. To identify how to build a data warehouse and query it (using open source tools like Pentaho Data Integration and Pentaho Business Analytics)
2. To get an understanding of data mining tasks using a data mining toolkit (such as open source WEKA)
3. To understand the data sets and data preprocessing
4. To study the working of algorithms for data mining tasks such as association rulemining, classification, clustering and regression
5. To get acquainted to the data mining techniques with varied input values for different parameters

LIST OF EXPERIMENTS: Experiments using Weka / Clementine Tools

1. Installation of WEKA Tool
2. Creating new Arff File
3. Data Processing Techniques on Data set.
4. Data cube construction – OLAP operations
5. Implementation of Apriori algorithm
6. Implementation of FP – Growth algorithm
7. Implementation of Decision Tree Induction
8. Calculating Information gain measures
9. Classification of data using Bayesian approach
10. Classification of data using K – Nearest Neighbor Approach.
11. Implementation of K – means algorithm

COURSE OUTCOMES:

1. To specify which data processing technique can be applied
2. To construct a Data cube
3. To implement mining algorithms as a component to the existing tools
4. To differentiate the approaches based on classification
5. To associate mining techniques for realistic data

DATA WAREHOUSING AND DATA MINING LAB

Table of Contents

DATAWARE HOUSE TOOLS

Cloudera	
Teradata	
Oracle	
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OPEN SOURCE DATA MINING TOOLS

WEKA	
Orange	
KNIME	
R-Programming	

Experiment 1: Installation of WEKA Tool

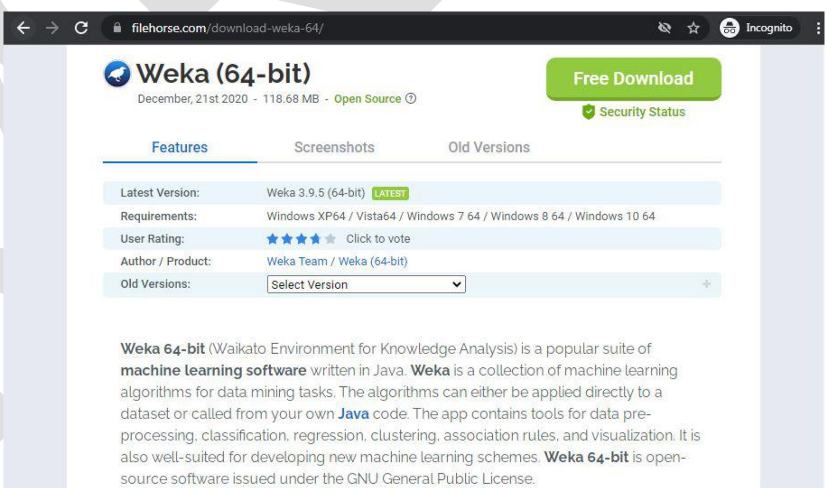
Introduction

Weka (pronounced to rhyme with Mecca) is a workbench that contains a collection of visualization tools and algorithms for data analysis and predictive modeling, together with graphical user interfaces for easy access to these functions. The original non-Java version of Weka was a Tcl/Tk front-end to (mostly third-party) modeling algorithms implemented in other programming languages, plus data preprocessing utilities in C, and Make file-based system for running machine learning experiments. This original version was primarily designed as a tool for analyzing data from agricultural domains, but the more recent fully Java-based version (Weka 3), for which development started in 1997, is now used in many different application areas, in particular for educational purposes and research. Advantages of Weka include:

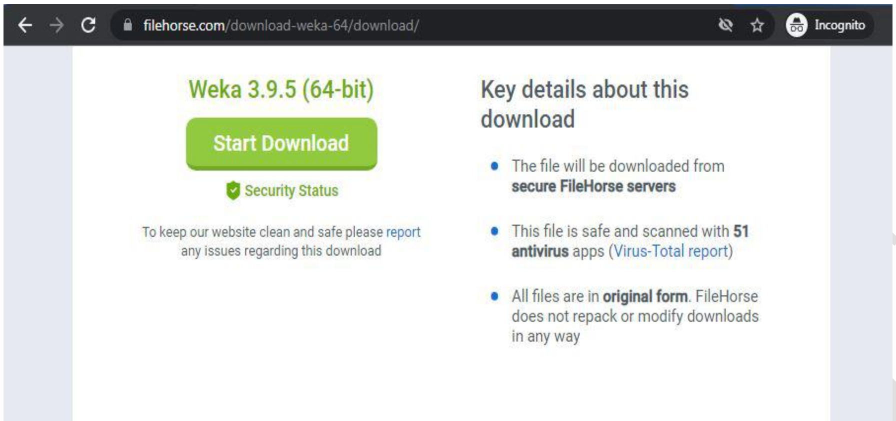
- Free availability under the GNU General Public License.
- Portability, since it is fully implemented in the Java programming language and thus runs on almost any modern computing platform
- A comprehensive collection of data preprocessing and modeling techniques
- Ease of use due to its graphical user interfaces

Installing Weka on Windows:

Step 1: Visit this website using any web browser. Click on Free Download.

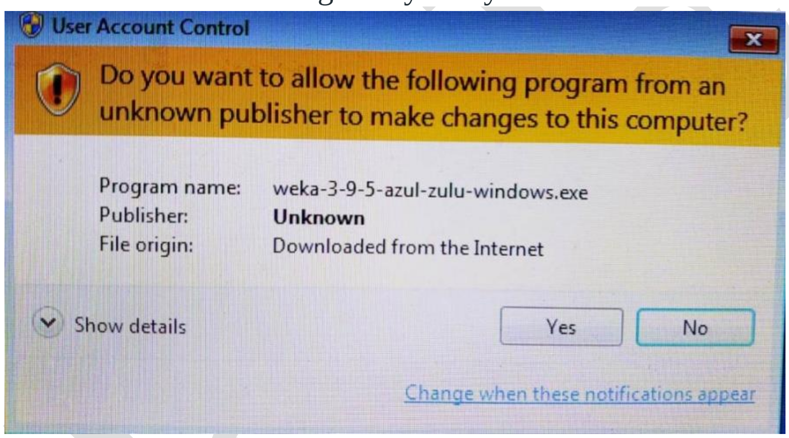


Step 2: It will redirect to a new webpage, click on Start Download. Downloading of the executable file will start shortly. It is a big 118 MB file that will take some minutes



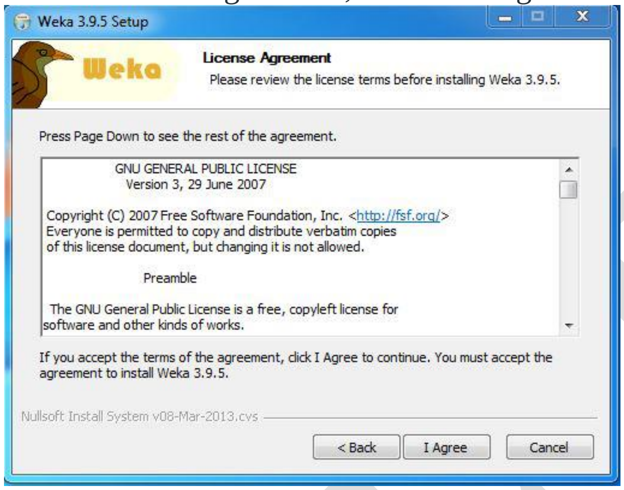
Step 3: Now check for the executable file in downloads in your system and run it.

Step 4: It will prompt confirmation to make changes to your system. Click on Yes.

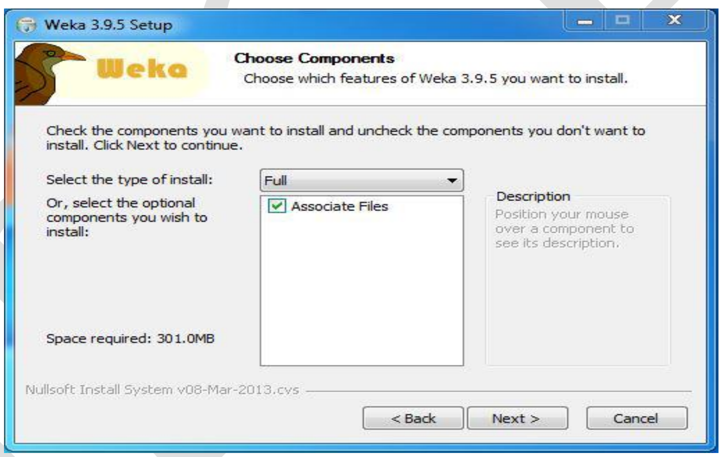


Step 5: Setup screen will appear, click on Next.

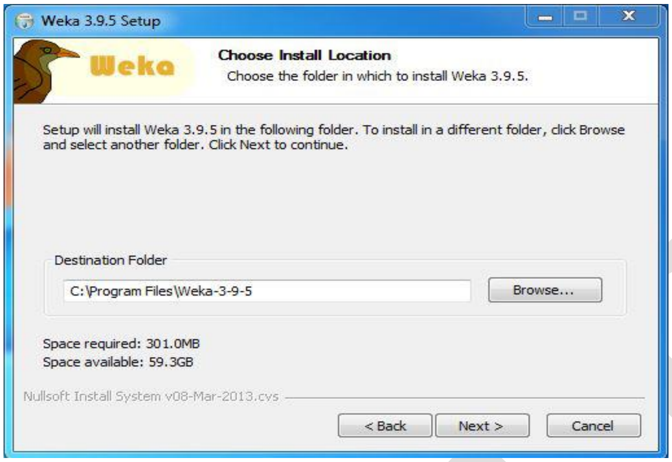
Step 6: The next screen will be of License Agreement, click on I Agree.



Step 7: Next screen is of choosing components, all components are already marked so don't change anything just click on the Install button**.**



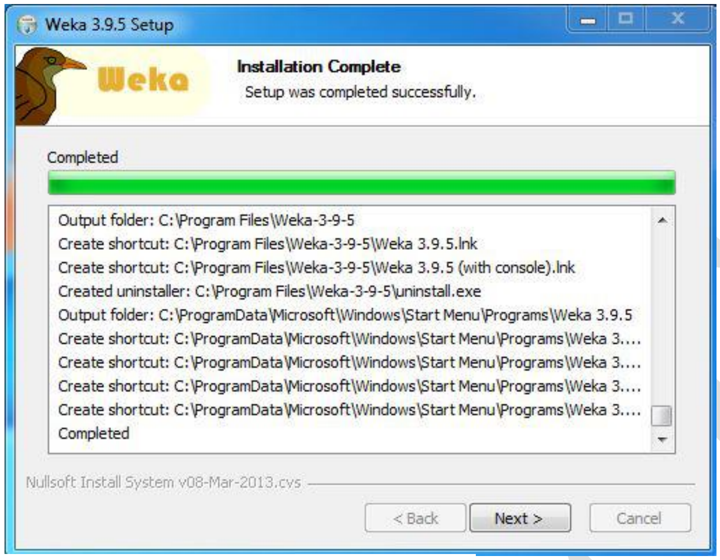
Step 8: The next screen will be of installing location so choose the drive which will have sufficient memory space for installation. It needed a memory space of 301 MB.



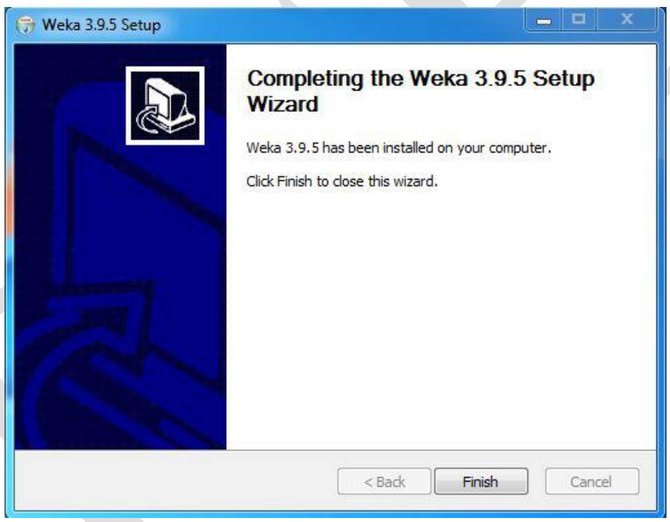
Step 9: Next screen will be of choosing the Start menu folder so don't do anything just click on Install Button.

Step 10: After this installation process will start and will hardly take a minute to complete the installation.

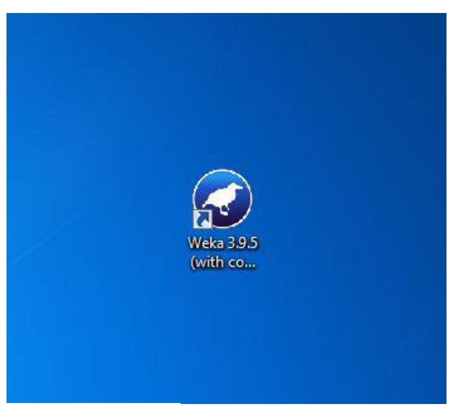
Step 11: Click on the Next button after the installation process is complete.



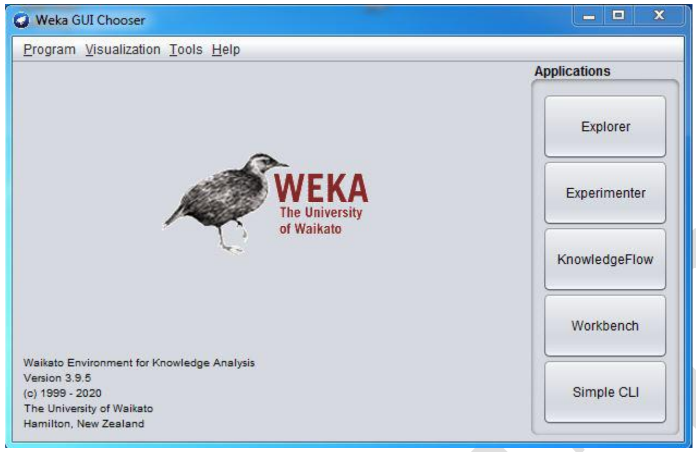
Step 12: **Click on Finish to finish the installation process.**



Step 13: Weka is successfully installed on the system and an icon is created on the desktop.



Step 14: Run the software and see the interface.



WEKA Tool Description:

Open the program. Once the program has been loaded on the user's machine it is opened by navigating to the programs start option and that will depend on the users operating system. Figure 1.1 is an example of the initial opening screen on a computer.

There are four options available on this initial screen:

Fig: 1.1 Weka GUI

1. Explorer - the graphical interface used to conduct experimentation on raw data After clicking the Explorer button the weka explorer interface appears.

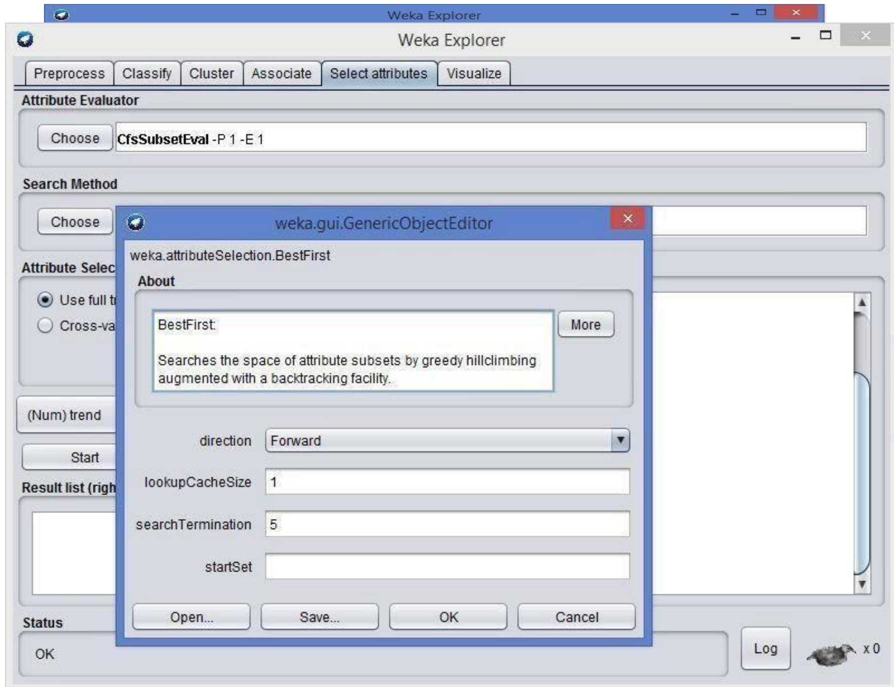
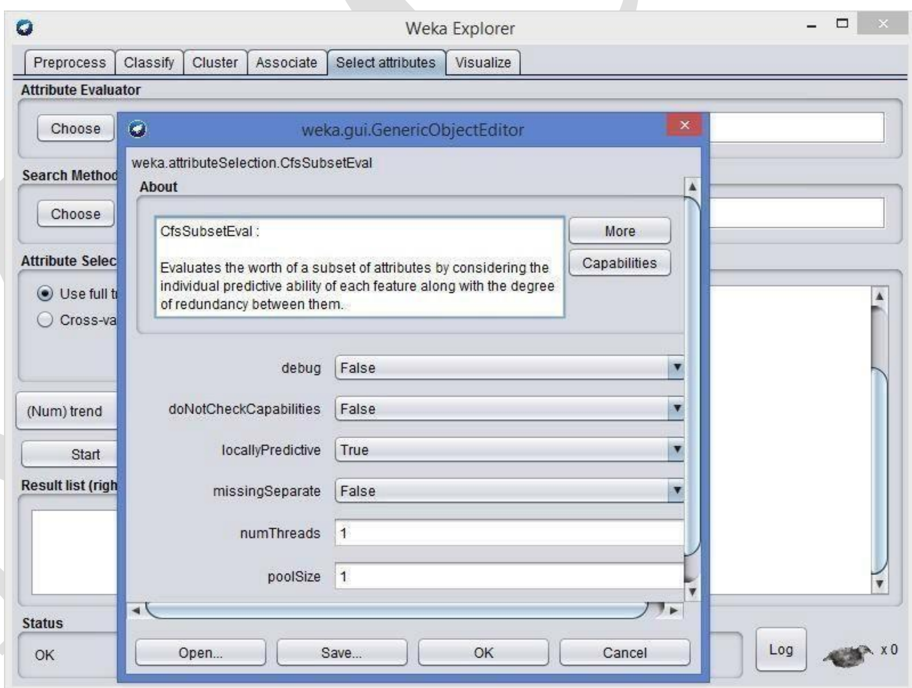


Fig: 1.2 Pre-processor



Inside the weka explorer window there are six tabs:

1. **Preprocess-** used to choose the data file to be used by the application.

   Open File- allows for the user to select files residing on the local machine or recorded medium

   Open URL- provides a mechanism to locate a file or data source from a different location specified by the user

   Open Database- allows the user to retrieve files or data from a database source provided by user

2. **Classify-** used to test and train different learning schemes on the preprocessed data file under experimentation

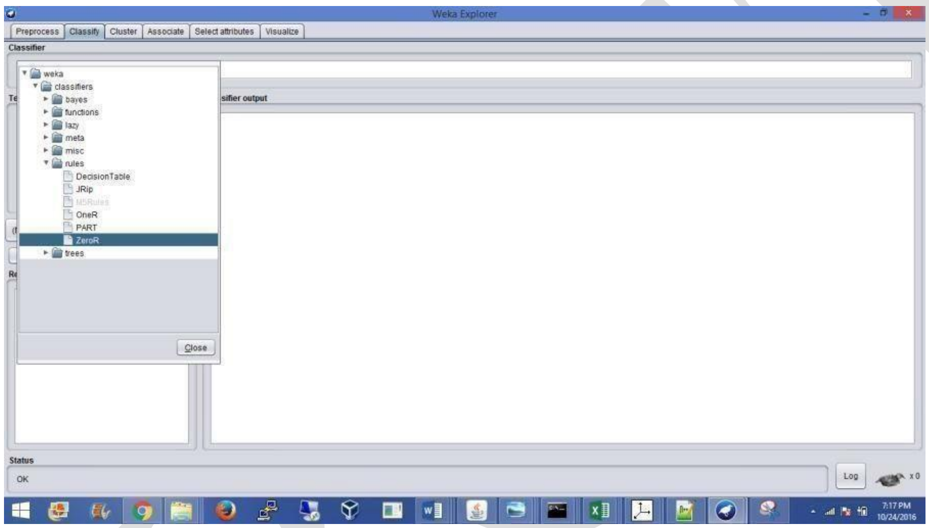


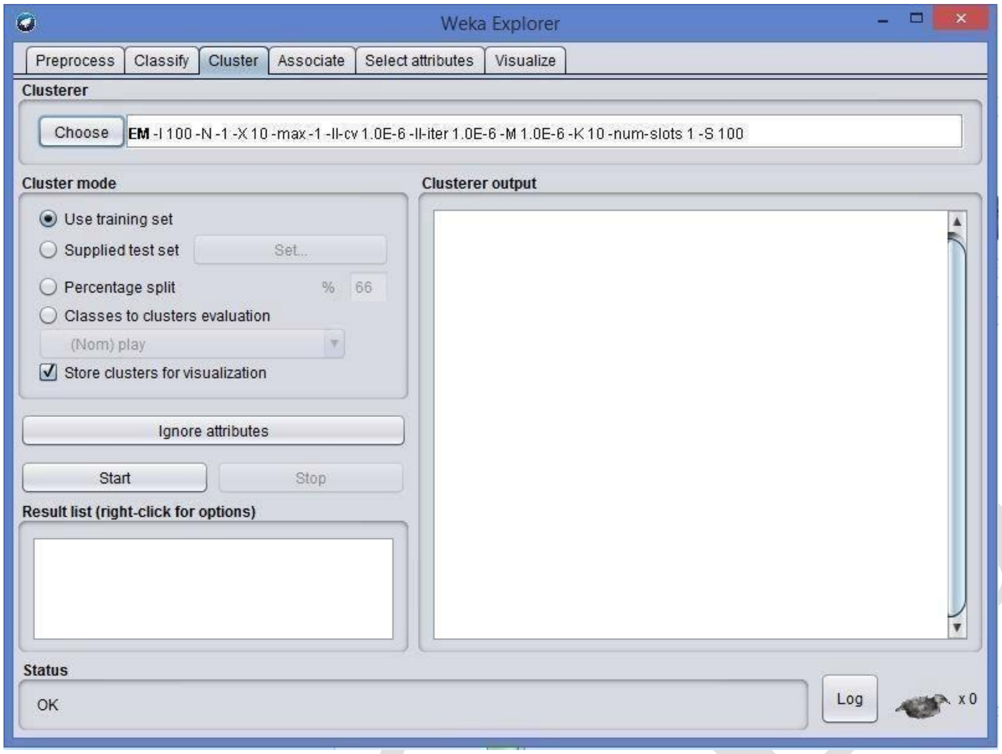
Fig: 1.3 choosing Zero set from classify

Again there are several options to be selected inside of the classify tab. Test option gives the user the choice of using four different test mode scenarios on the data set.

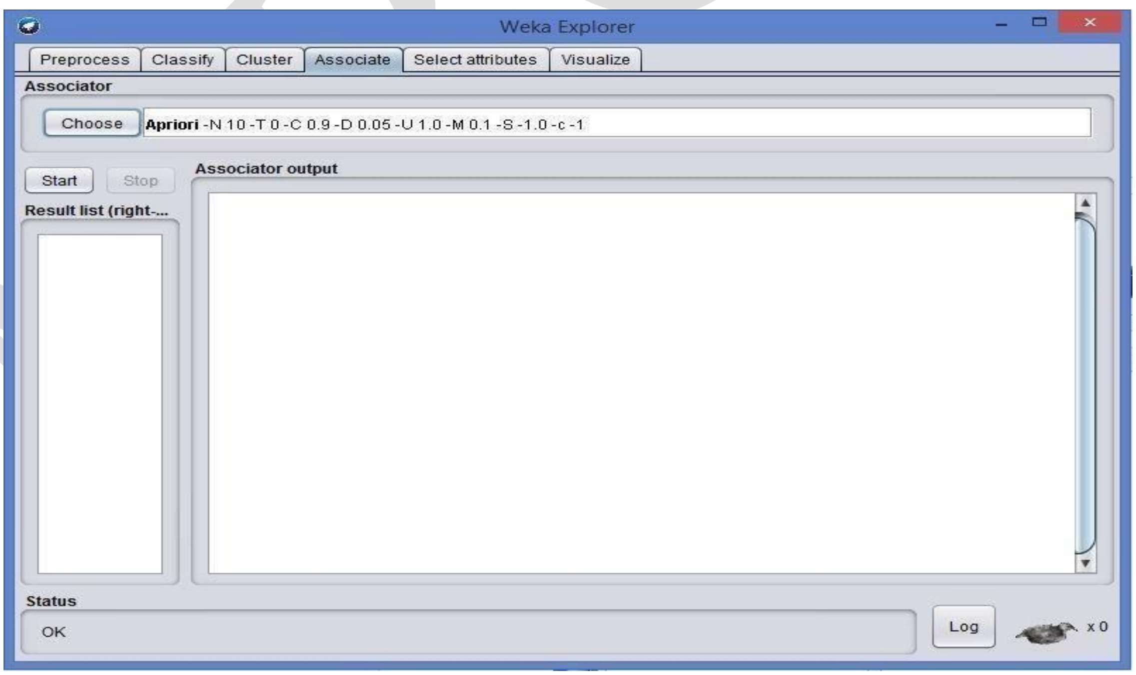
1. Use training set
2. Supplied training set
3. Cross validation
4. Split percentage

3. **Cluster-** used to apply different tools that identify clusters within the data file.

The Cluster tab opens the process that is used to identify commonalties or clusters of occurrences within the data set and produce information for the user to analyze.



4. **Association-** used to apply different rules to the data file that identify association within the data. The associate tab opens a window to select the options for associations within thedataset.



5. **Select attributes-**used to apply different rules to reveal changes based on selected attributes inclusion or exclusion from the experiment

6. **Visualize-** used to see what the various manipulation produced on the data set in a 2D format, in scatter plot and bar graph output.

2. Experimenter - this option allows users to conduct different experimental variations on data sets and perform statistical manipulation. The Weka Experiment Environment enables the user to create, run, modify, and analyze experiments in a more convenient manner than is possible when processing the schemes individually. For example, the user can create an experiment that runs several schemes against a series of datasets and then analyze the results to determine if one of the schemes is (statistically) better than the other schemes.

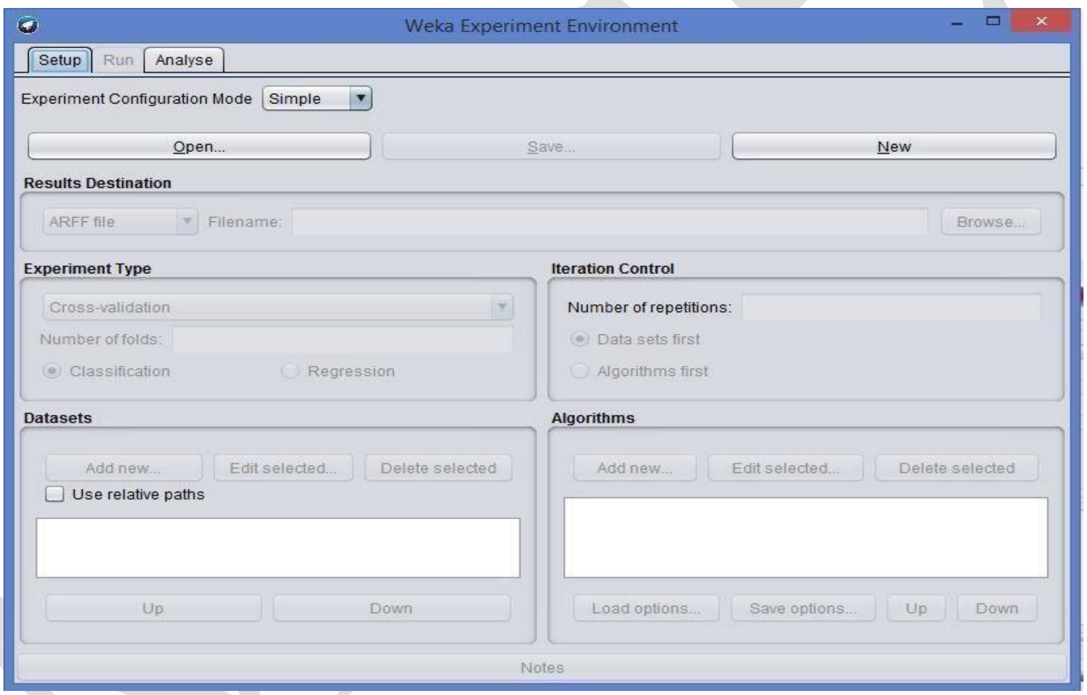


Fig: 1.6 Weka experiment

Results destination: ARFF file, CSV file, JDBC database.

Experiment type: Cross-validation (default), Train/Test Percentage Split (data randomized).

Iteration control: Number of repetitions, Data sets first/Algorithms first.

Algorithms: filters

3. Knowledge Flow -basically the same functionality as Explorer with drag and drop functionality. The advantage of this option is that it supports incremental learning from previous results

4. Simple CLI - provides users without a graphic interface option the ability to execute commands from a terminal window.

b. Explore the default datasets in weka tool.

Click the "***Open file…***" button to open a data set and double click on the "***data***" directory.

Weka provides a number of small common machine learning datasets that you can use to practice on.

Select the "***iris.arff***" file to load the Iris dataset.

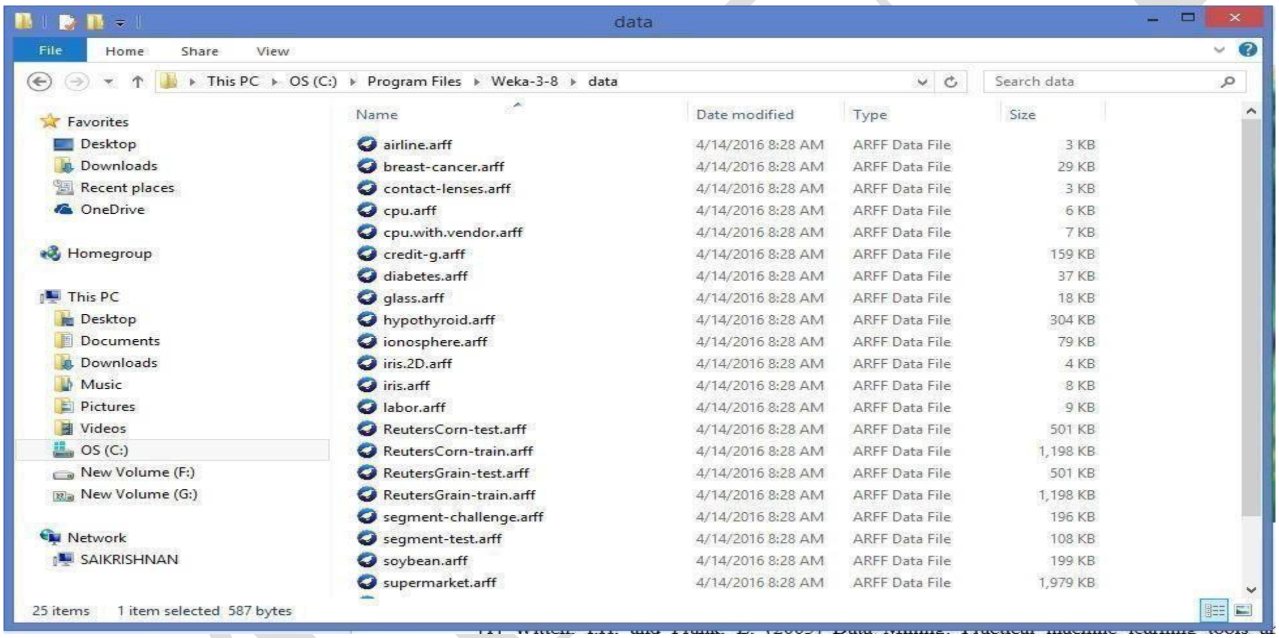


Fig: 1.7 Different Data Sets in weka

Exercise:

1. Normalize the data using min-max normalization

Record Notes

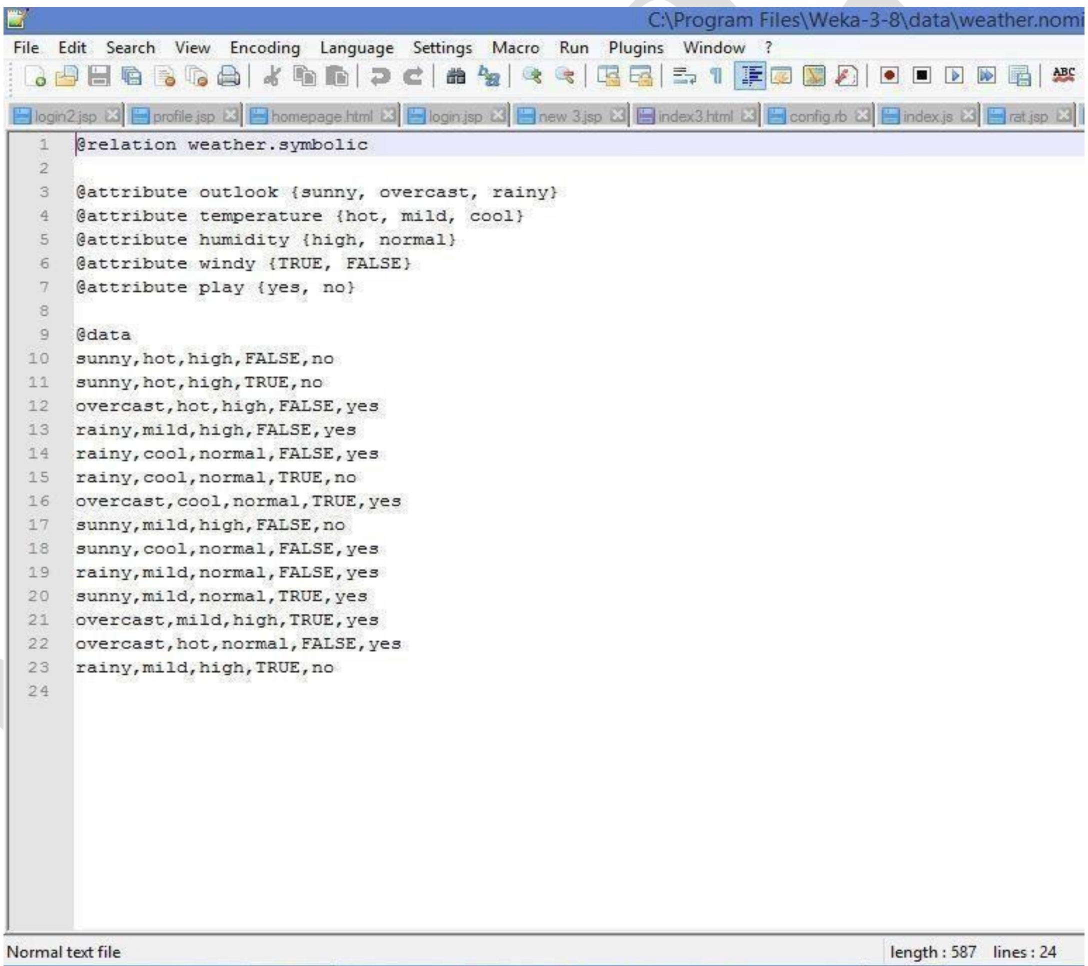
Signature of the Faculty

Experiment 2: Creating new ARFF file

Aim: Creating a new ARFF file

An ARFF (Attribute-Relation File Format) file is an ASCII text file that describes a list of instances sharing a set of attributes. ARFF files were developed by the Machine Learning Project at the Department of Computer Science of The University of Waikato for use with the Weka machine learning software in WEKA, each data entry is an instance of the java class weka.core. Instance, and each instance consists of a For loading datasets in WEKA, WEKA can load ARFF files. Attribute Relation File Format has two sections:

1. The Header section defines relation (dataset) name, attribute name, and type.
2. The Data section lists the data instances.



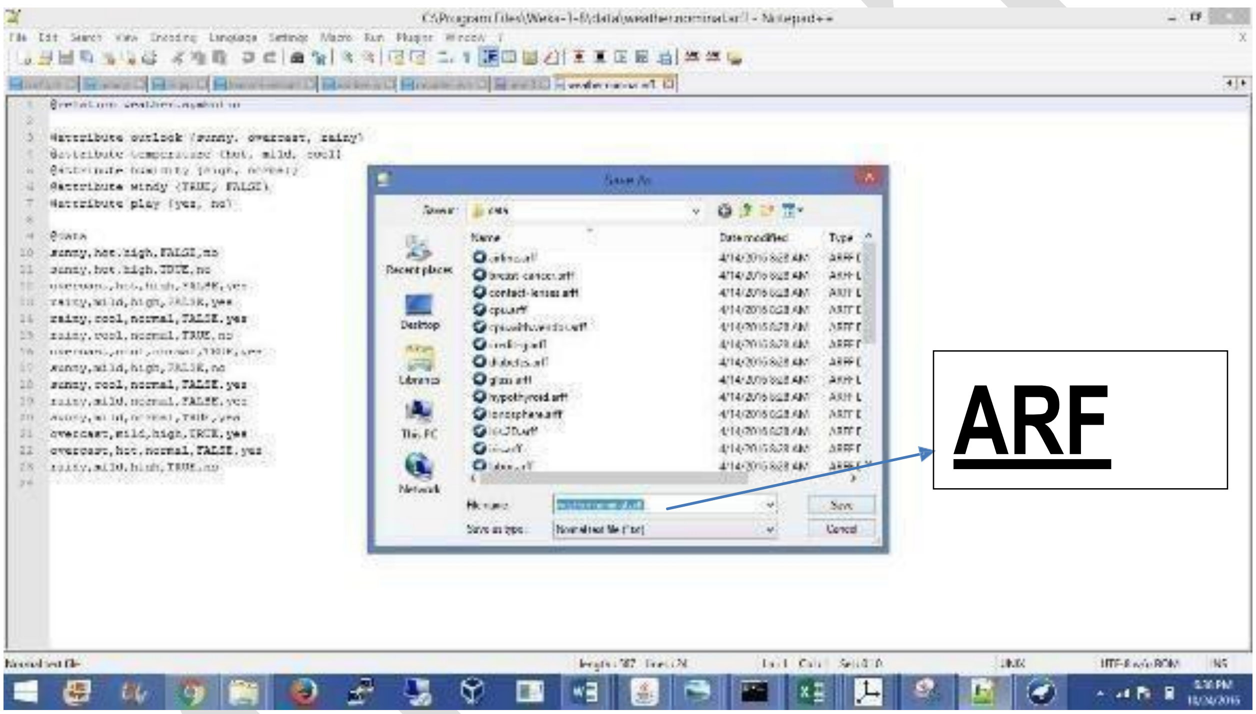

```
@relation weather.symbolic

@attribute outlook {sunny, overcast, rainy}
@attribute temperature {hot, mild, cool}
@attribute humidity {high, normal}
@attribute windy {TRUE, FALSE}
@attribute play {yes, no}

@data
sunny,hot,high,FALSE,no
sunny,hot,high,TRUE,no
overcast,hot,high,FALSE,yes
rainy,mild,high,FALSE,yes
rainy,cool,normal,FALSE,yes
rainy,cool,normal,TRUE,no
overcast,cool,normal,TRUE,yes
sunny,mild,high,FALSE,no
sunny,cool,normal,FALSE,yes
rainy,mild,normal,FALSE,yes
sunny,mild,normal,TRUE,yes
overcast,mild,high,TRUE,yes
overcast,hot,normal,FALSE,yes
rainy,mild,high,TRUE,no
```

The figure above is from the textbook that shows an ARFF file for the weather data. Lines beginning with a % sign are comments. And there are three basic keywords:

- "@relation" in Header section, followed with relation name.
- "@attribute" in Header section, followed with attributes name and its type (or range).
- "@data" in Data section, followed with the list of data instances.

The external representation of an Instances class Consists of:

- **A header:** Describes the attribute types
- **Data section:** Comma separated list of data



References:

https://www.cs.auckland.ac.nz/courses/compsci367s1c/tutorials/IntroductionToWeka.pdf

Exercise:

1. Creating a sample dataset for supermarket (supermarket.arff)

Record Notes

Signature of the Faculty

Experiment 3: Data Processing Techniques on Data Set

Aim: 3a) Pre-process a given dataset based on Attribute selection

To search through all possible combinations of attributes in the data and find which subset of attributes works best for prediction, make sure that you set up attribute evaluator to „Cfs Subset Val‟ and a search method to „Best First‟. The evaluator will determine what method to use toassign a worth to each subset of attributes. The search method will determine what style of search to perform. The options that you can set for selection in the „Attribute Selection Mode‟ fig no: 3.2

1. **Use full training set.** The worth of the attribute subset is determined using the full set of training data.

2. **Cross-validation.** The worth of the attribute subset is determined by a process of cross-validation. The „Fold‟ and „Seed‟ fields set the number of folds to use and the random seed used when shuffling the data.

Specify which attribute to treat as the class in the drop-down box below the test options. Once all the test options are set, you can start the attribute selection process by clicking on „Start‟ button.

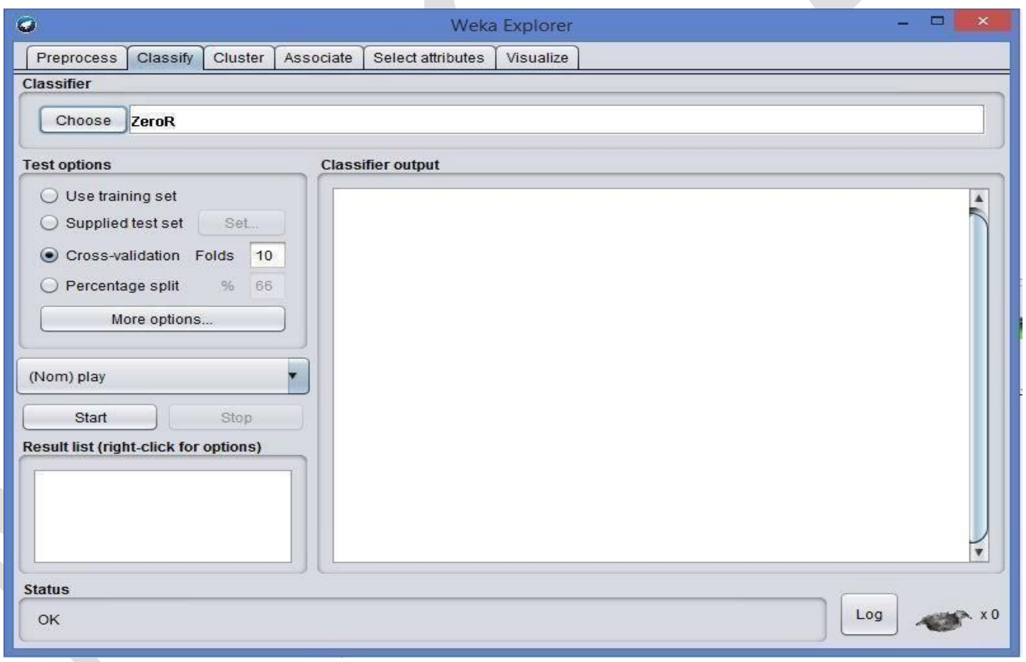


Fig: 3.1 choosing Cross validation

When it is finished, the results of selection are shown on the right part of the window and entry is added to the „Result list‟.

2. Visualizing Results

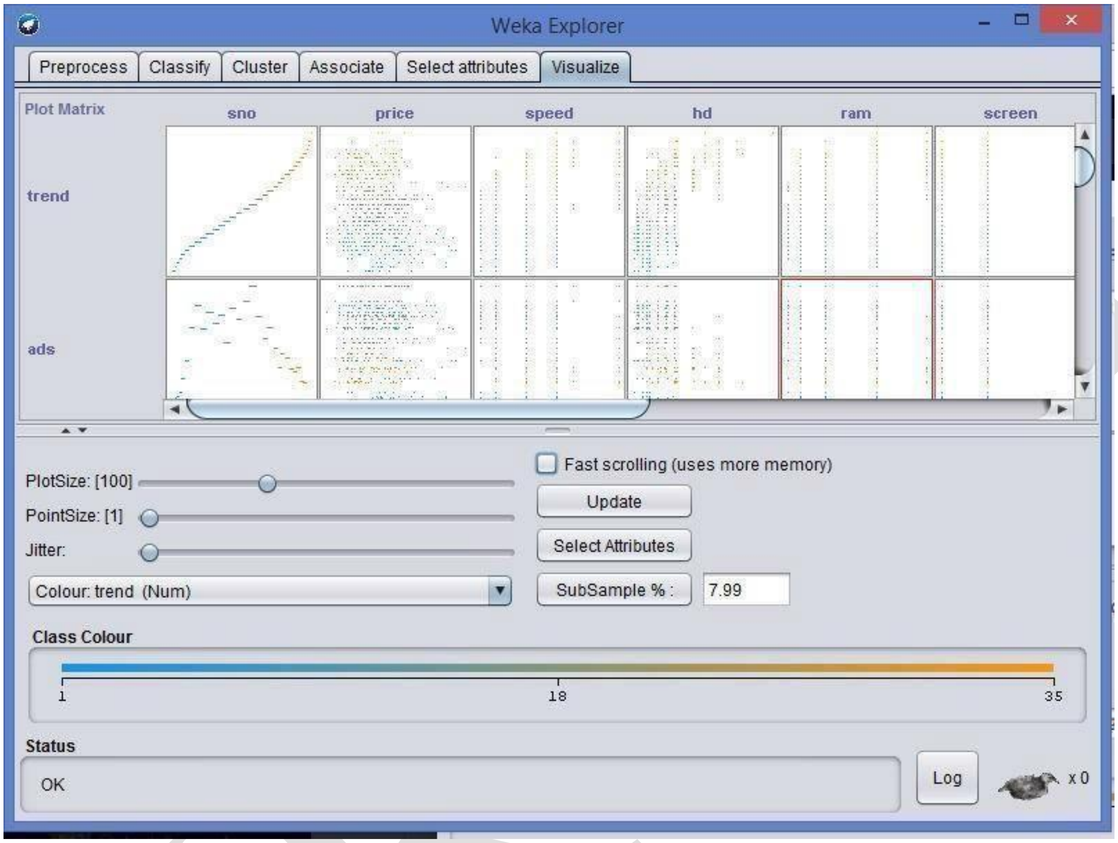


Fig: 3.2 Data Visualization

WEKA‟s visualization allows you to visualize a 2-D plot of the current working relation. Visualization is very useful in practice; it helps to determine difficulty of the learning problem. WEKA can visualize single attributes (1-d) and pairs of attributes (2-d), rotate 3-d visualizations (Xgobi-style). WEKA has "Jitter" option to deal with nominal attributes and to detect "hidden" data points.

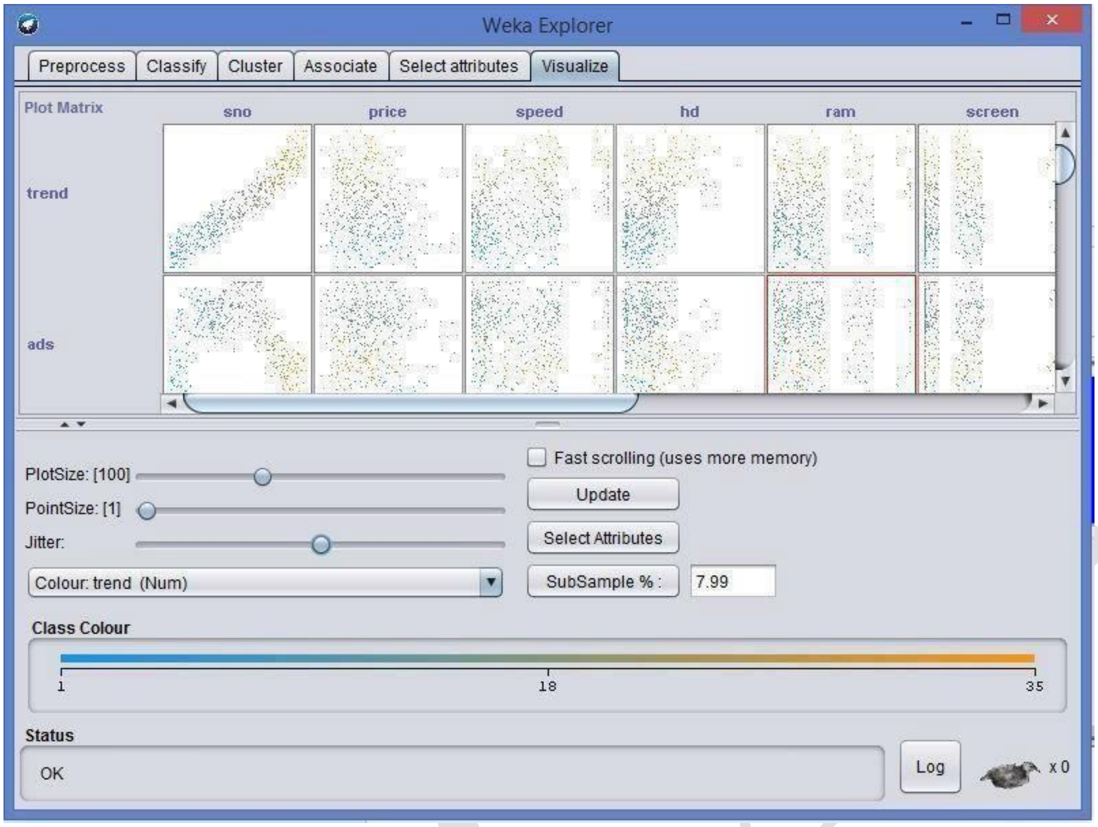


Fig 3.3: Preprocessing with jitter

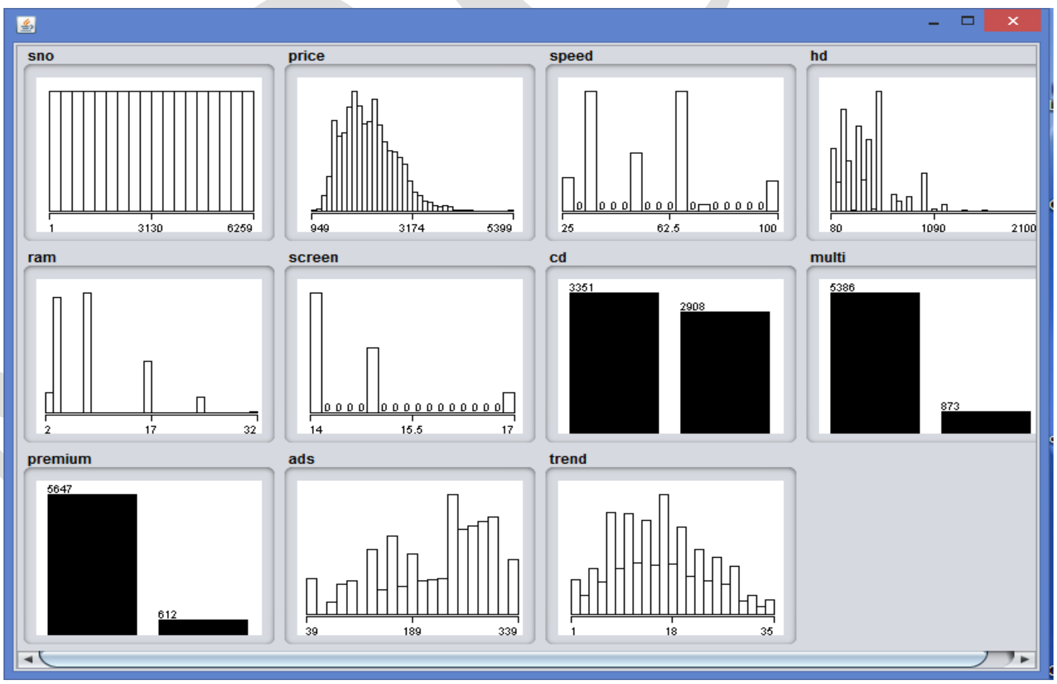


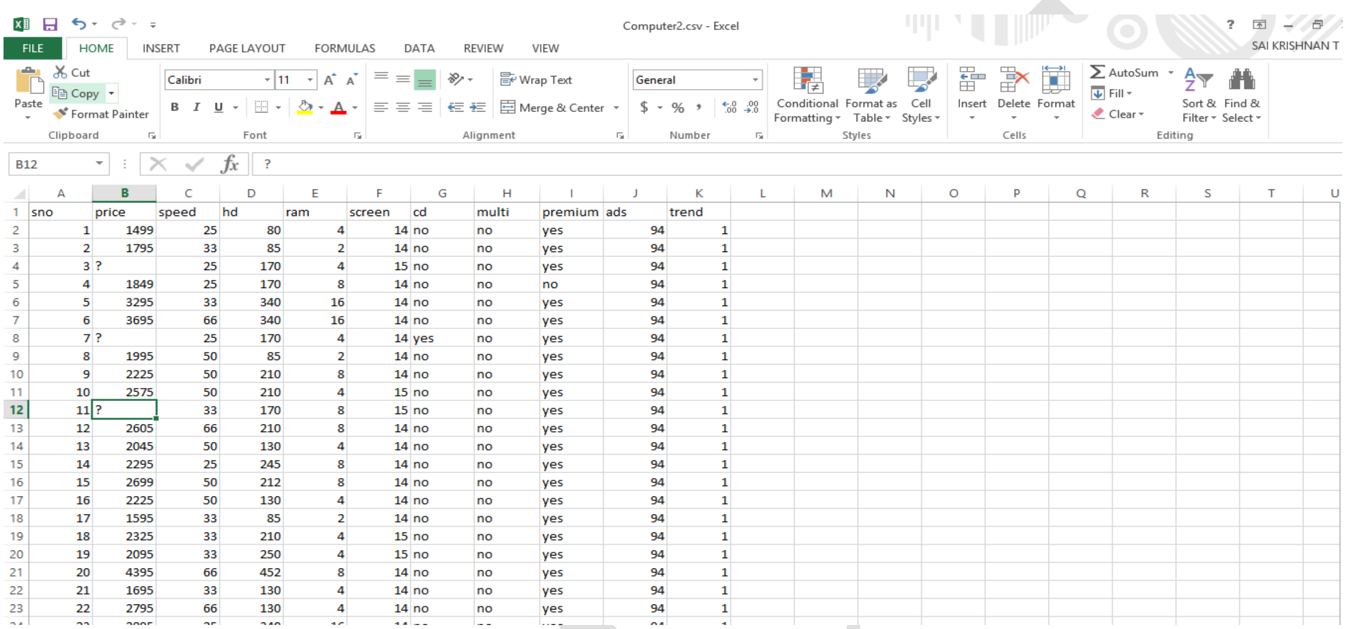
Fig: 3.3 Data visualization

Exercise

1. Explain data preprocessing steps for heart disease dataset.

Aim: B. Pre-process a given dataset based on Handling Missing Values

Process: Replacing Missing Attribute Values by the Attribute Mean. This method is used for data sets with numerical attributes. An example of such a data set is presented in fig no: 3.4



sno	price	speed	hd	ram	screen	cd	multi	premium	ads	trend
1	1499	25	80	4	14	no	no	yes	94	1
2	1795	33	85	2	14	no	no	yes	94	1
3	?	25	170	4	15	no	no	yes	94	1
4	1849	25	170	8	14	no	no	no	94	1
5	3295	33	340	16	14	no	no	yes	94	1
6	3695	66	340	16	14	no	no	yes	94	1
7	?	25	170	4	14	yes	no	yes	94	1
8	1995	50	85	2	14	no	no	yes	94	1
9	2225	50	210	8	14	no	no	yes	94	1
10	2575	50	210	4	15	no	no	yes	94	1
11	?	33	170	8	15	no	no	yes	94	1
12	2605	66	210	8	14	no	no	yes	94	1
13	2045	50	130	4	14	no	no	yes	94	1
14	2295	25	245	8	14	no	no	yes	94	1
15	2699	50	212	8	14	no	no	yes	94	1
16	2225	50	130	4	14	no	no	yes	94	1
17	1595	33	85	2	14	no	no	yes	94	1
18	2325	33	210	4	15	no	no	yes	94	1
19	2095	33	250	4	15	no	no	yes	94	1
20	4395	66	452	8	14	no	no	yes	94	1
21	1695	33	130	4	14	no	no	yes	94	1
22	2795	66	130	4	14	no	no	yes	94	1

Fig: 3.4 Missing values

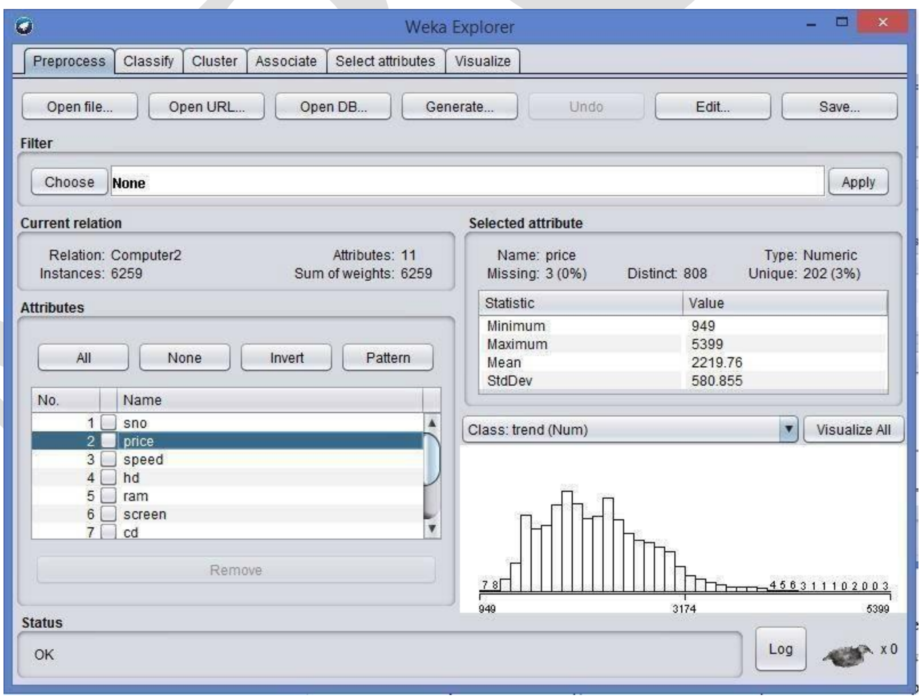
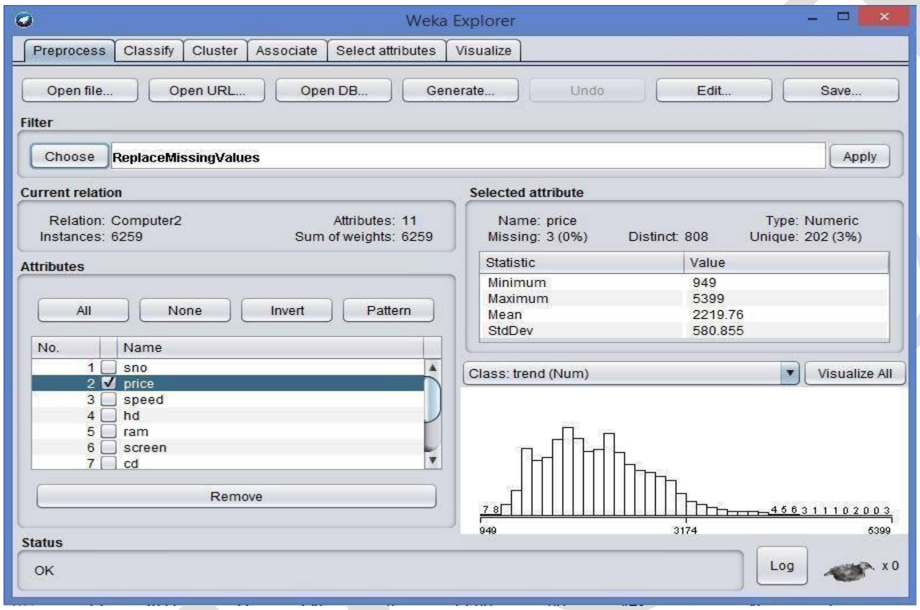
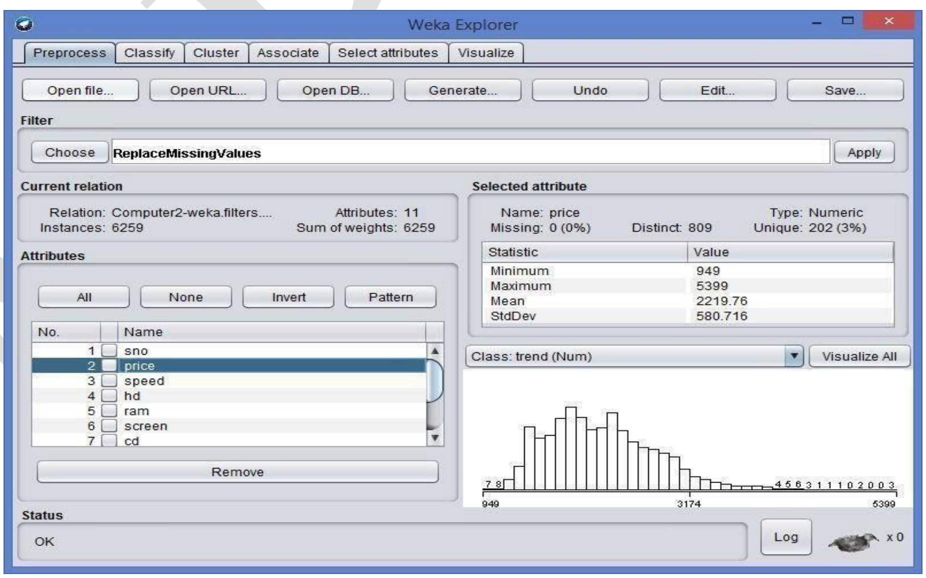
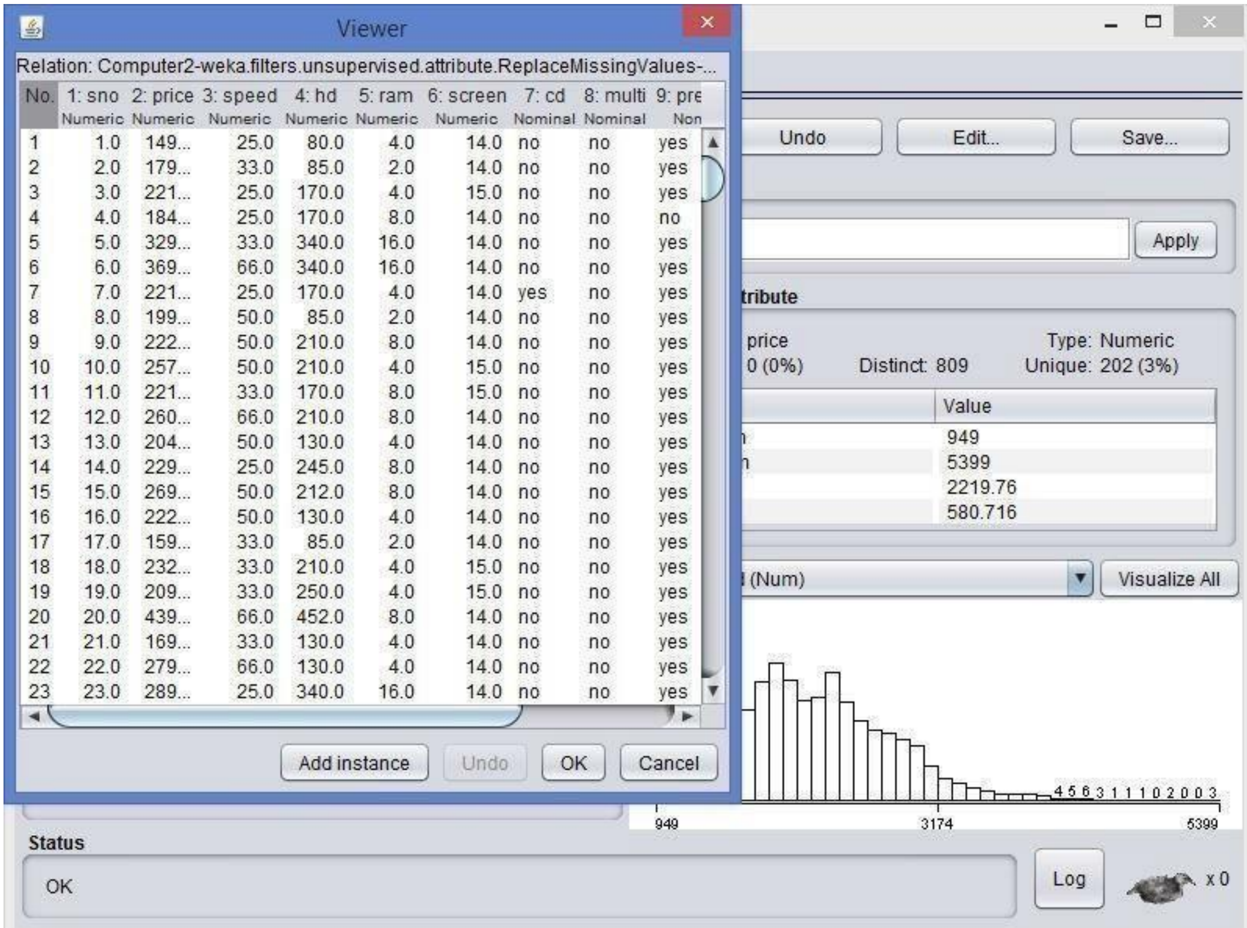


Fig: 3.5 Choosing a dataset

In this method, every missing attribute value for a numerical attribute is replaced by the arithmetic mean of known attribute values. In Fig, the mean of known attribute values for Temperature is 99.2, hence all missing attribute values for Temperature should be replaced by The table with missing attribute values replaced by the mean is presented in fig. For symbolic attributes Headache and Nausea, missing attribute values were replaced using the most common value of the Replace Missing Values.







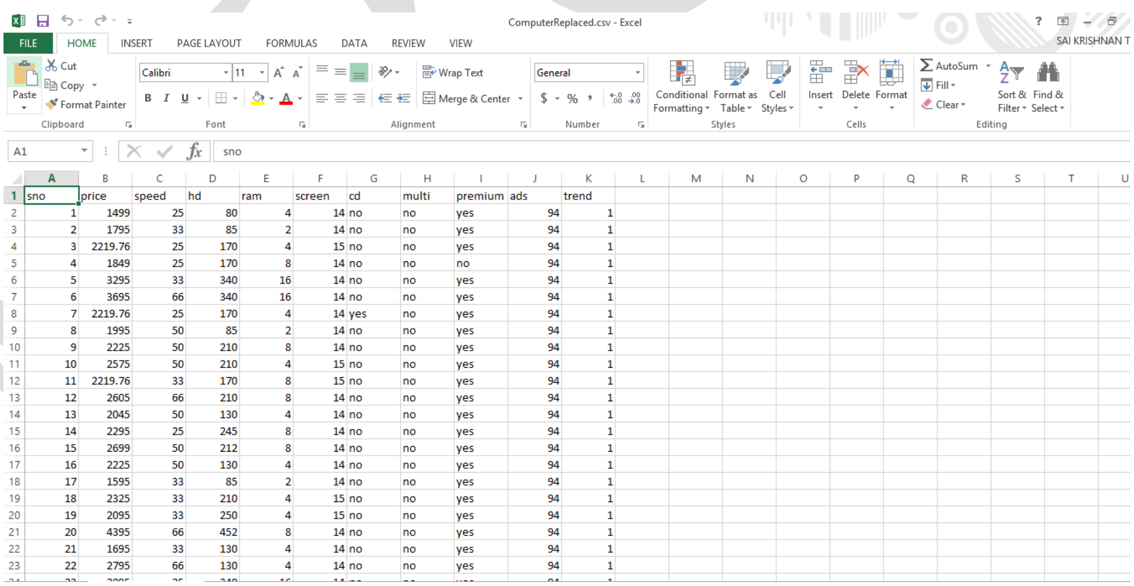


Fig: 3.6 Replaced values

Exercise

1. Create your own dataset having missing values included and perform preprocessing

Record Notes

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Experiment 4: Data cube construction – OLAP operations

An OLAP cube is a term that typically refers to multi-dimensional array of data. OLAP is an acronym for online analytical processing,[1]which is a computer-based technique of analyzing data to look for insights. The term cube here refers to a multi-dimensional dataset, which is also sometimes called a hypercube if the number of dimensions is greater than 3.

Operations:

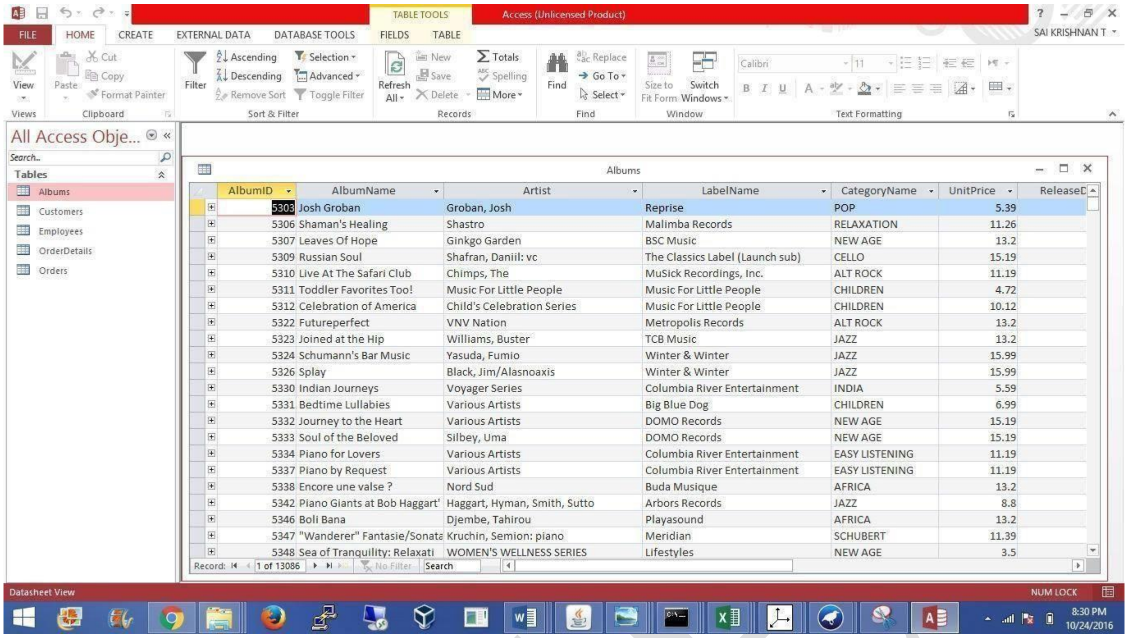
1. **Slice** is the act of picking a rectangular subset of a cube by choosing a single value for one of its dimensions, creating a new cube with one fewer dimension.[4] The picture shows a slicing operation: The sales figures of all sales regions and all product categories of the company in the year 2005 and 2006 are "sliced" out of the data cube.

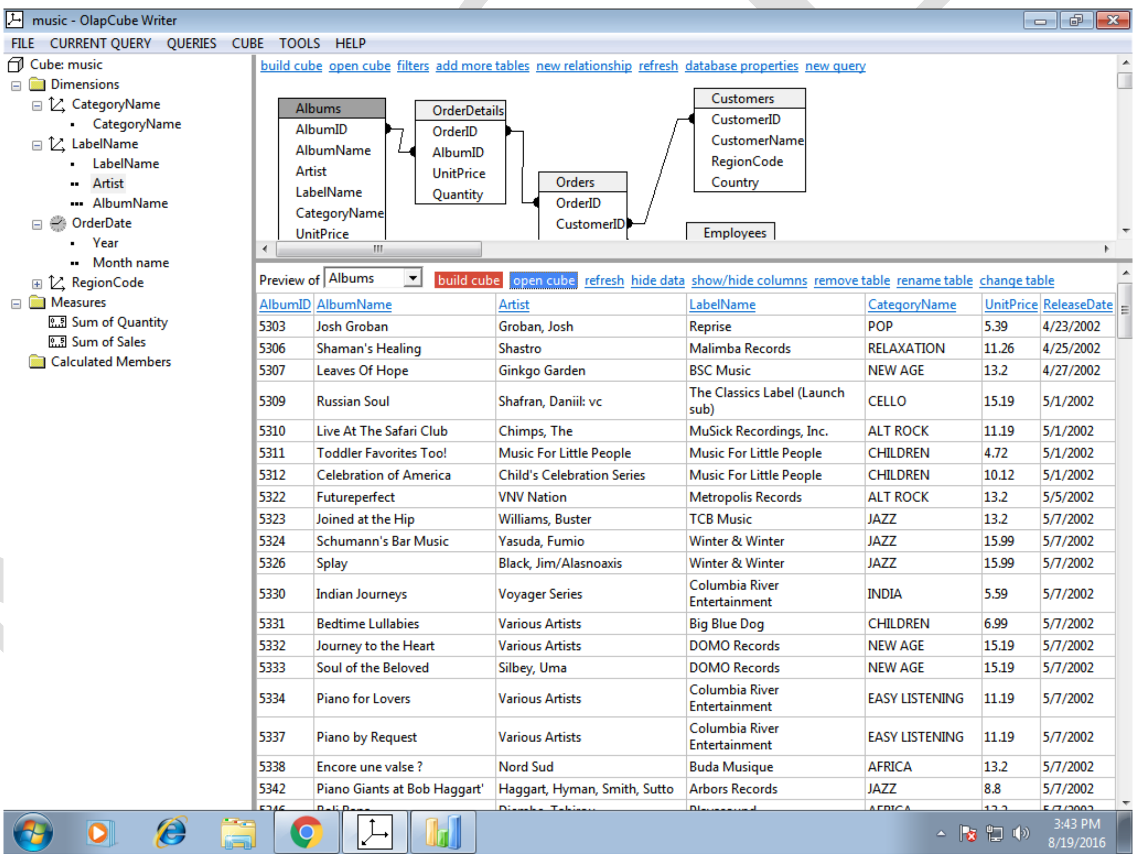
2. **Dice:** The dice operation produces a subcube by allowing the analyst to pick specific values of multiple dimensions.[5]The picture shows a dicing operation: The new cube shows the sales figures of a limited number of product categories, the time and region dimensions cover the same range as before.

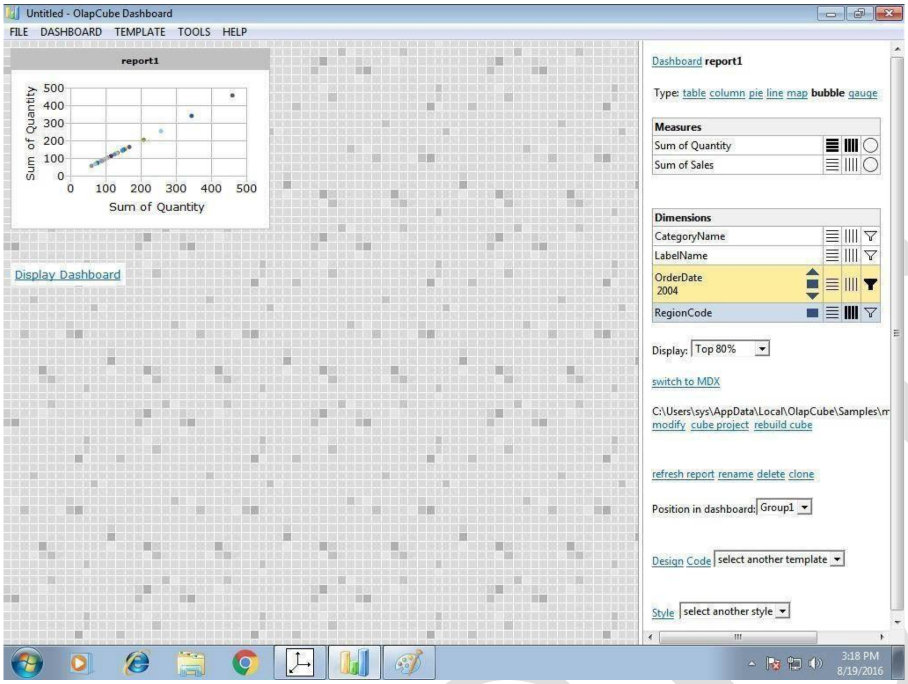
3. **Drill Down/Up** allows the user to navigate among levels of data ranging from the most summarized (up) to the most detailed (down).[4] The picture shows a drill-down operation: The analyst moves from the summary category "Outdoor-Schutzausrüstung" to see the sales figures for the individual products.

4. **Roll-up:** A roll-up involves summarizing the data along a dimension. The summarization rule might be computing totals along a hierarchy or applying a set of formulas such as "profit = sales - expenses".

5. **Pivot** allows an analyst to rotate the cube in space to see its various faces. For example, cities could be arranged vertically and products horizontally while viewing data for a particular quarter. Pivoting could replace products with time periods to see data across time for a single product.


Access (Unlicensed Product)
TABLE TOOLS
FILE HOME CREATE EXTERNAL DATA DATABASE TOOLS FIELDS TABLE
All Access Obje...
Tables
Albums
Customers
Employees
OrderDetails
Orders
Albums
AlbumID AlbumName Artist LabelName CategoryName UnitPrice
5303 Josh Groban Groban, Josh Reprise POP 5.39
5306 Shaman's Healing Shastro Malimba Records RELAXATION 11.26
5307 Leaves Of Hope Ginkgo Garden BSC Music NEW AGE 13.2
5309 Russian Soul Shafran, Daniil: vc The Classics Label (Launch sub) CELLO 15.19
5310 Live At The Safari Club Chimps, The MuSick Recordings, Inc. ALT ROCK 11.19
5311 Toddler Favorites Too! Music For Little People Music For Little People CHILDREN 4.72
5312 Celebration of America Child's Celebration Series Music For Little People CHILDREN 10.12
5322 Futureperfect VNV Nation Metropolis Records ALT ROCK 13.2
5323 Joined at the Hip Williams, Buster TCB Music JAZZ 13.2
5324 Schumann's Bar Music Yasuda, Fumio Winter & Winter JAZZ 15.99
5326 Splay Black, Jim/Alasnoaxis Winter & Winter JAZZ 15.99
5330 Indian Journeys Voyager Series Columbia River Entertainment INDIA 5.59
5331 Bedtime Lullabies Various Artists Big Blue Dog CHILDREN 6.99
5332 Journey to the Heart Various Artists DOMO Records NEW AGE 15.19
5333 Soul of the Beloved Silbey, Uma DOMO Records NEW AGE 15.19
5334 Piano for Lovers Various Artists Columbia River Entertainment EASY LISTENING 11.19
5337 Piano by Request Various Artists Columbia River Entertainment EASY LISTENING 11.19
5338 Encore une valse ? Nord Sud Buda Musique AFRICA 13.2
5342 Piano Giants at Bob Haggart' Haggart, Hyman, Smith, Sutto Arbors Records JAZZ 8.8
5346 Boli Bana Djembe, Tahirou Playasound AFRICA 13.2
5347 "Wanderer" Fantasie/Sonata Kruchin, Semion: piano Meridian SCHUBERT 11.39
5348 Sea of Tranquility: Relaxati WOMEN'S WELLNESS SERIES Lifestyles NEW AGE 3.5
Record: 1 of 13086
Datasheet View
NUM LOCK
8:30 PM
10/24/2016


music - OlapCube Writer
FILE CURRENT QUERY QUERIES CUBE TOOLS HELP
Cube: music
Dimensions
CategoryName
CategoryName
LabelName
LabelName
Artist
AlbumName
OrderDate
Year
Month name
RegionCode
Measures
Sum of Quantity
Sum of Sales
Calculated Members
build cube open cube filters add more tables new relationship refresh database properties new query
Albums AlbumID AlbumName Artist LabelName CategoryName UnitPrice
OrderDetails OrderID AlbumID UnitPrice Quantity
Orders OrderID CustomerID
Customers CustomerID CustomerName RegionCode Country
Employees
Preview of Albums build cube open cube refresh hide data show/hide columns remove table rename table change table
AlbumID AlbumName Artist LabelName CategoryName UnitPrice ReleaseDate
5303 Josh Groban Groban, Josh Reprise POP 5.39 4/23/2002
5306 Shaman's Healing Shastro Malimba Records RELAXATION 11.26 4/25/2002
5307 Leaves Of Hope Ginkgo Garden BSC Music NEW AGE 13.2 4/27/2002
5309 Russian Soul Shafran, Daniil: vc The Classics Label (Launch sub) CELLO 15.19 5/1/2002
5310 Live At The Safari Club Chimps, The MuSick Recordings, Inc. ALT ROCK 11.19 5/1/2002
5311 Toddler Favorites Too! Music For Little People Music For Little People CHILDREN 4.72 5/1/2002
5312 Celebration of America Child's Celebration Series Music For Little People CHILDREN 10.12 5/1/2002
5322 Futureperfect VNV Nation Metropolis Records ALT ROCK 13.2 5/5/2002
5323 Joined at the Hip Williams, Buster TCB Music JAZZ 13.2 5/7/2002
5324 Schumann's Bar Music Yasuda, Fumio Winter & Winter JAZZ 15.99 5/7/2002
5326 Splay Black, Jim/Alasnoaxis Winter & Winter JAZZ 15.99 5/7/2002
5330 Indian Journeys Voyager Series Columbia River Entertainment INDIA 5.59 5/7/2002
5331 Bedtime Lullabies Various Artists Big Blue Dog CHILDREN 6.99 5/7/2002
5332 Journey to the Heart Various Artists DOMO Records NEW AGE 15.19 5/7/2002
5333 Soul of the Beloved Silbey, Uma DOMO Records NEW AGE 15.19 5/7/2002
5334 Piano for Lovers Various Artists Columbia River Entertainment EASY LISTENING 11.19 5/7/2002
5337 Piano by Request Various Artists Columbia River Entertainment EASY LISTENING 11.19 5/7/2002
5338 Encore une valse ? Nord Sud Buda Musique AFRICA 13.2 5/7/2002
5342 Piano Giants at Bob Haggart' Haggart, Hyman, Smith, Sutto Arbors Records JAZZ 8.8 5/7/2002
3:43 PM
8/19/2016


Untitled - OlapCube Dashboard
FILE DASHBOARD TEMPLATE TOOLS HELP
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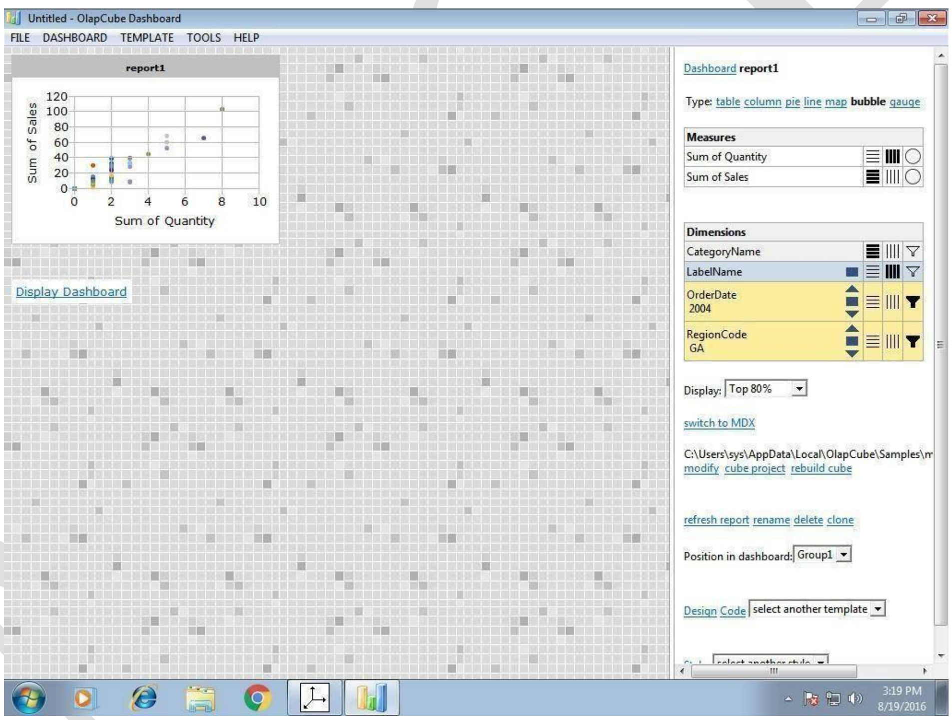
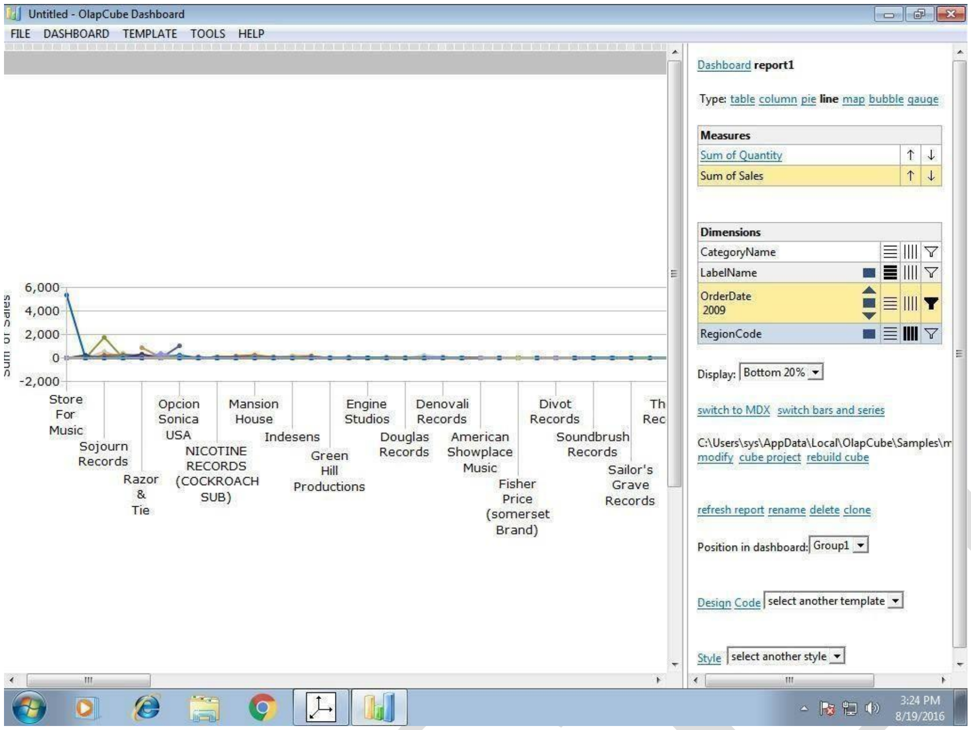
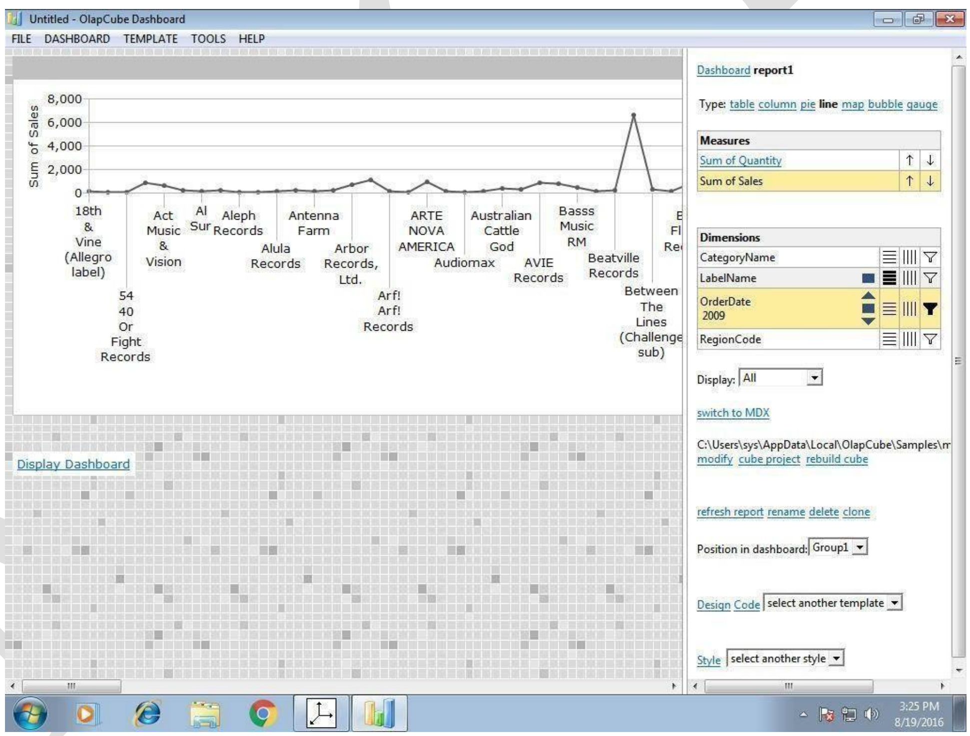
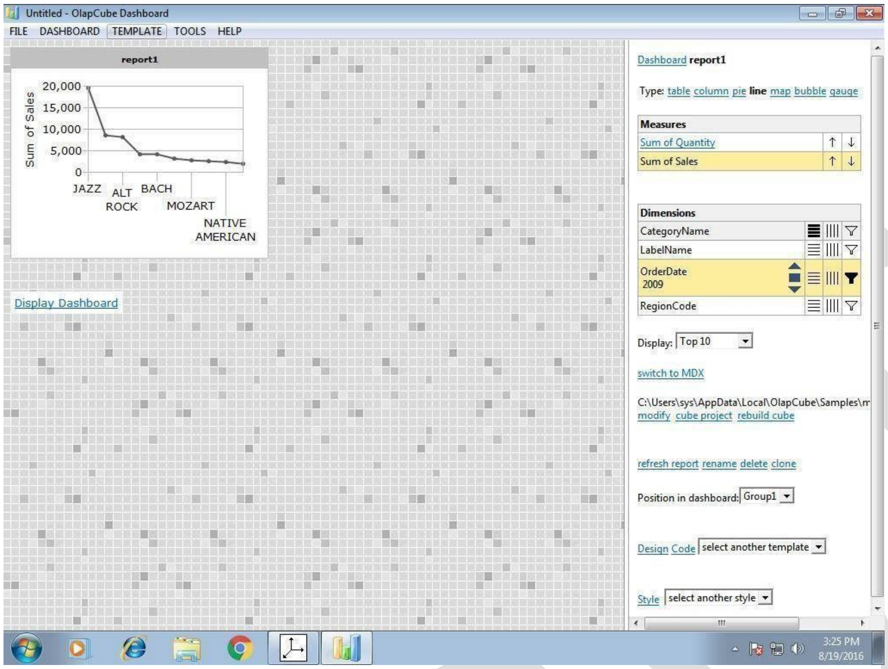
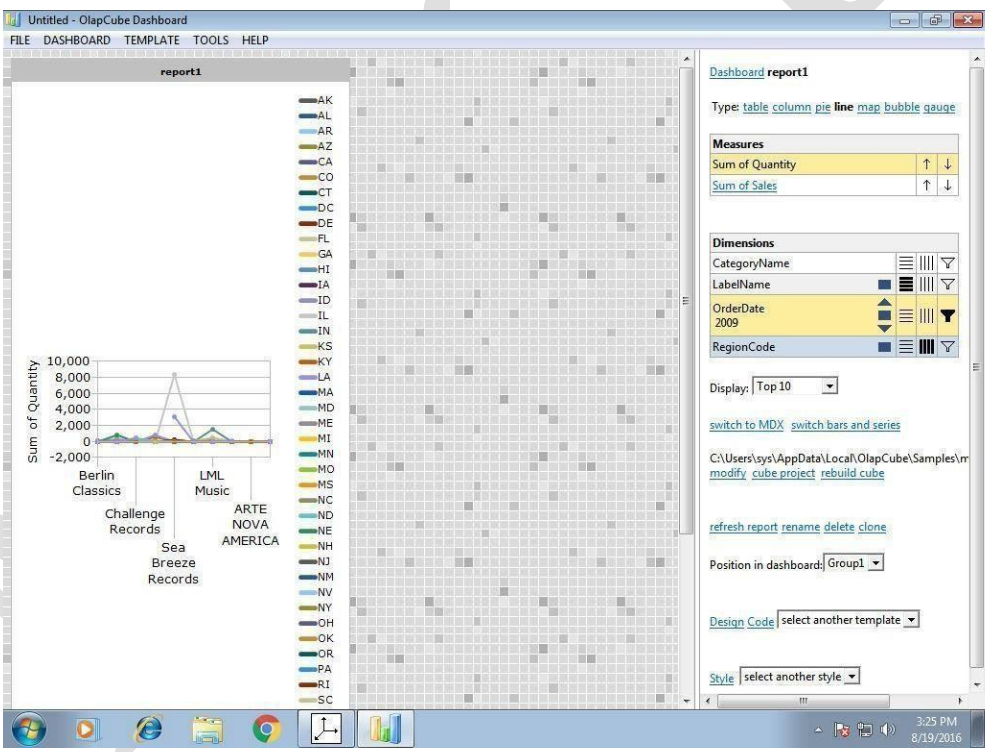
Sum of Quantity
Display Dashboard
Dashboard report1
Type: table column pie line map bubble gauge
Measures
Sum of Quantity
Sum of Sales
Dimensions
CategoryName
LabelName
OrderDate
2004
RegionCode
Display: Top 80%
switch to MDX
modify cube project rebuild cube
refresh report rename delete clone
Position in dashboard: Group1
Design Code select another template
Style select another style
3:18 PM
8/19/2016


Untitled - OlapCube Dashboard
FILE DASHBOARD TEMPLATE TOOLS HELP
report1
Sum of Sales
Sum of Quantity
Display Dashboard
Dashboard report1
Type: table column pie line map bubble gauge
Measures
Sum of Quantity
Sum of Sales
Dimensions
CategoryName
LabelName
OrderDate
2004
RegionCode
GA
Display: Top 80%
switch to MDX
modify cube project rebuild cube
refresh report rename delete clone
Position in dashboard: Group1
Design Code select another template
3:19 PM
8/19/2016









Exercise:

1. Apply the OLAP operations for the banking application.

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Experiment 5: Implementation of Apriori Algorithm

Description:

The Apriori algorithm is an influential algorithm for mining frequent item sets for Boolean association rules. It uses a “bottom-up” approach, where frequent subsets are extended one at a time (a step known as candidate generation, and groups of candidates are tested against the data).

- **Problem:**

TID	ITEMS
100	1,3,4
200	2,3,5
300	1,2,3,5
400	2,5

To find frequent item sets for above transaction with a minimum support of 2 having confidence measure of 70% (i.e, 0.7).

Procedure:

Step 1:

Count the number of transactions in which each item occurs

TID	ITEMS
1	2
2	3
3	3
4	1
5	3

Step 2:

Eliminate all those occurrences that have transaction numbers less than the minimum support (2 in this case).

ITEM	NO. OF TRANSACTIONS
1	2
2	3
3	3
5	3

This is the single items that are bought frequently. Now let's say we want to find a pair of items that are bought frequently. We continue from the above table (Table in step 2).

Step 3:

We start making pairs from the first item like 1,2;1,3;1,5 and then from second item like 2,3;2,5. We do not perform 2,1 because we already did 1,2 when we were making pairs with 1 and buying 1 and 2 together is same as buying 2 and 1 together. After making all the pairs we get,

ITEM PAIRS
1,2
1,3
1,5
2,3
2,5
3,5

Step 4:

Now, we count how many times each pair is bought together.

ITEM PAIRS	NO.OF TRANSACTIONS
1,2	1
1,3	2
1,5	1
2,3	2
2,5	3
3,5	2

Step 5:

Again remove all item pairs having number of transactions less than 2.

ITEM PAIRS	NO. OF TRANSACTIONS
1,3	2
2,3	2
2,5	3
3,5	2

These pair of items is bought frequently together. Now, let's say we want to find a set of three items that are bought together. We use above table (of step 5) and make a set of three items.

Step 6:

To make the set of three items we need one more rule (It is termed as self-join), it simply means, from item pairs in above table, we find two pairs with the same first numeric, so, we get (2,3) and (2,5), which gives (2,3,5). Then we find how many times (2, 3, 5) are bought together in the original table and we get the following

ITEM SET	**NO. OF TRANSACTIONS**
(2,3,5)	2

Thus, the set of three items that are bought together from this data are (2, 3, 5).

Confidence:

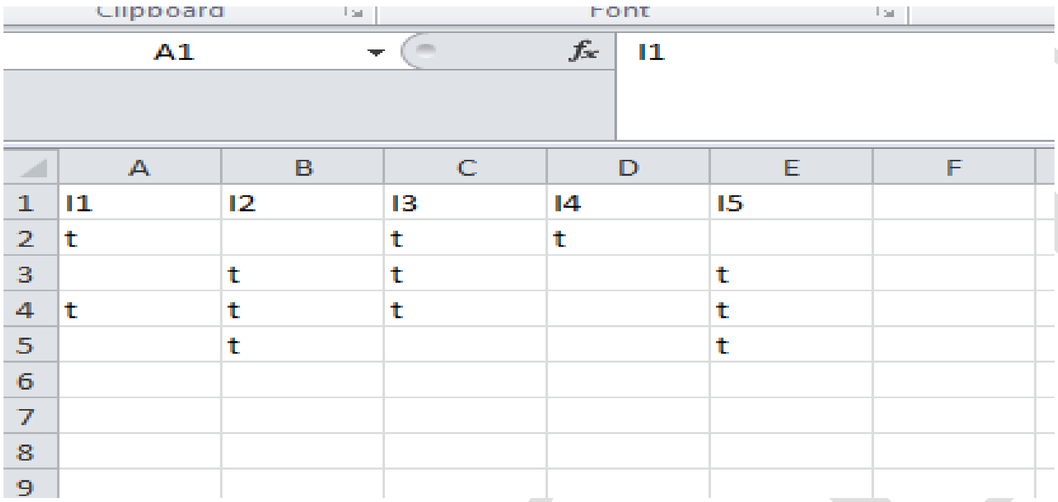
We can take our frequent item set knowledge even further, by finding association rules using the frequent item set. In simple words, we know (2, 3, 5) are bought together frequently, but what is the association between them. To do this, we create a list of all subsets of frequently bought items (2, 3, 5) in our case we get following subsets:

- {2}
- {3}
- {5}
- {2,3}
- {3,5}
- {2,5}

Now, we find association among all the subsets.
{2} => {3,5}:(If„2‟ is bought , what‟s the probability that „3‟ and „5‟ would be bought in same transaction)
Confidence = P (3□5□2)/ P(2) =2/3 =67%
{3}=>{2,5}= P (3□5□2)/P(3)=2/3=67%
{5}=>{2,3}= P (3□5□2)/P(5)=2/3=67%
{2,3}=>{5}= P (3□5□2)/P(2□3)=2/2=100%
{3,5}=>{2}= P (3□5□2)/P(3□5)=2/2=100%
{2,5}=>{3}= P (3□5□2)/ P(2□5)=2/3=67%
Also, considering the remaining 2-items sets, we would get the following associations-
{1}=>{3}=P(1□3)/P(1)=2/2=100%
{3}=>{1}=P(1□3)/P(3)=2/3=67%
{2}=>{3}=P(3□2)/P(2)=2/3=67%
{3}=>{2}=P(3□2)/P(3)=2/3=67%
{2}=>{5}=P(2□5)/P(2)=3/3=100%
{5}=>{2}=P(2□5)/P(5)=3/3=100%

{3}=>{5}=P(3□5)/P(3)=2/3=67%
{5}=>{3}=P(3□5)/P(5)=2?3=67%
Eliminate all those having confidence less than 70%. Hence, the rules would be –
{2,3}=>{5}, {3,5}=>{2}, {1}=>{3},{2}=>{5}, {5}=>{2}.

- Now these manual results should be checked with the rules generated in WEKA.



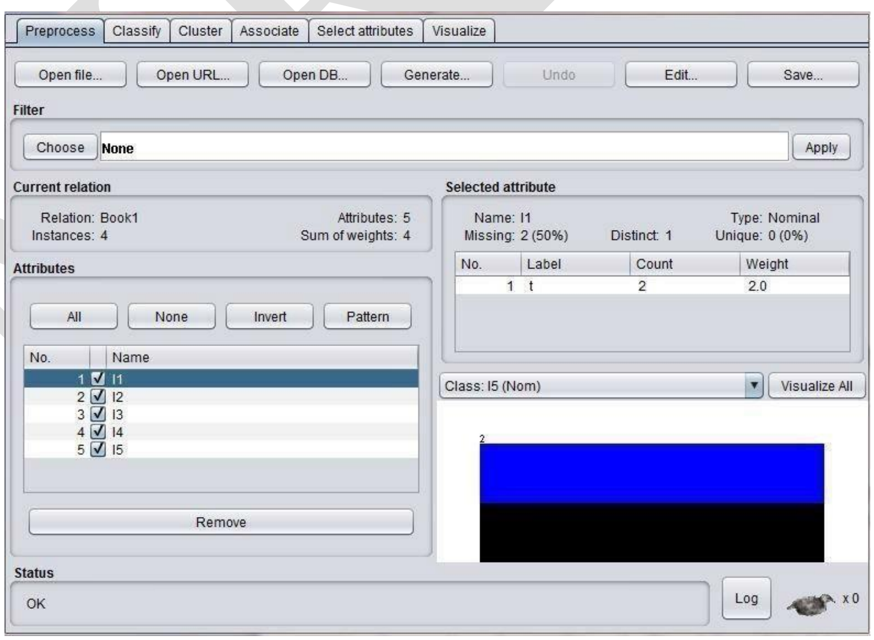
	A	B	C	D	E	F
1	I1	I2	I3	I4	I5	
2	t		t	t		
3		t	t		t	
4	t	t	t		t	
5		t			t	
6						
7						
8						
9						

So first create a csv file for the above problem, the csv file for the above problem will look like the rows and columns in the above figure. This file is written in excel sheet.

<u>Procedure for running the rules in weka:</u>

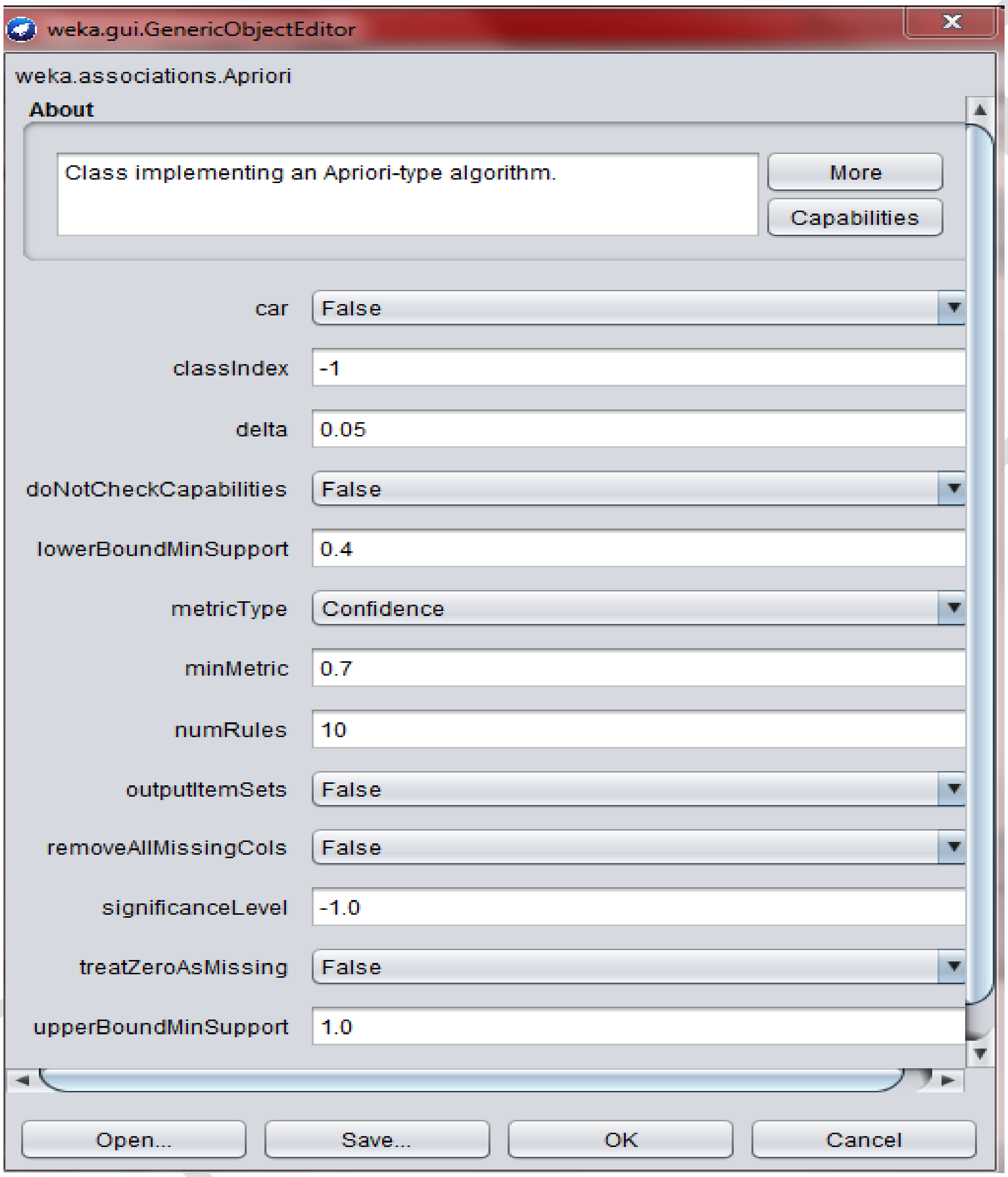
<u>Step 1:</u>

Open weka explorer and open the file and then select all the item sets. The figure gives a better understanding of how to do that.



Step 2:

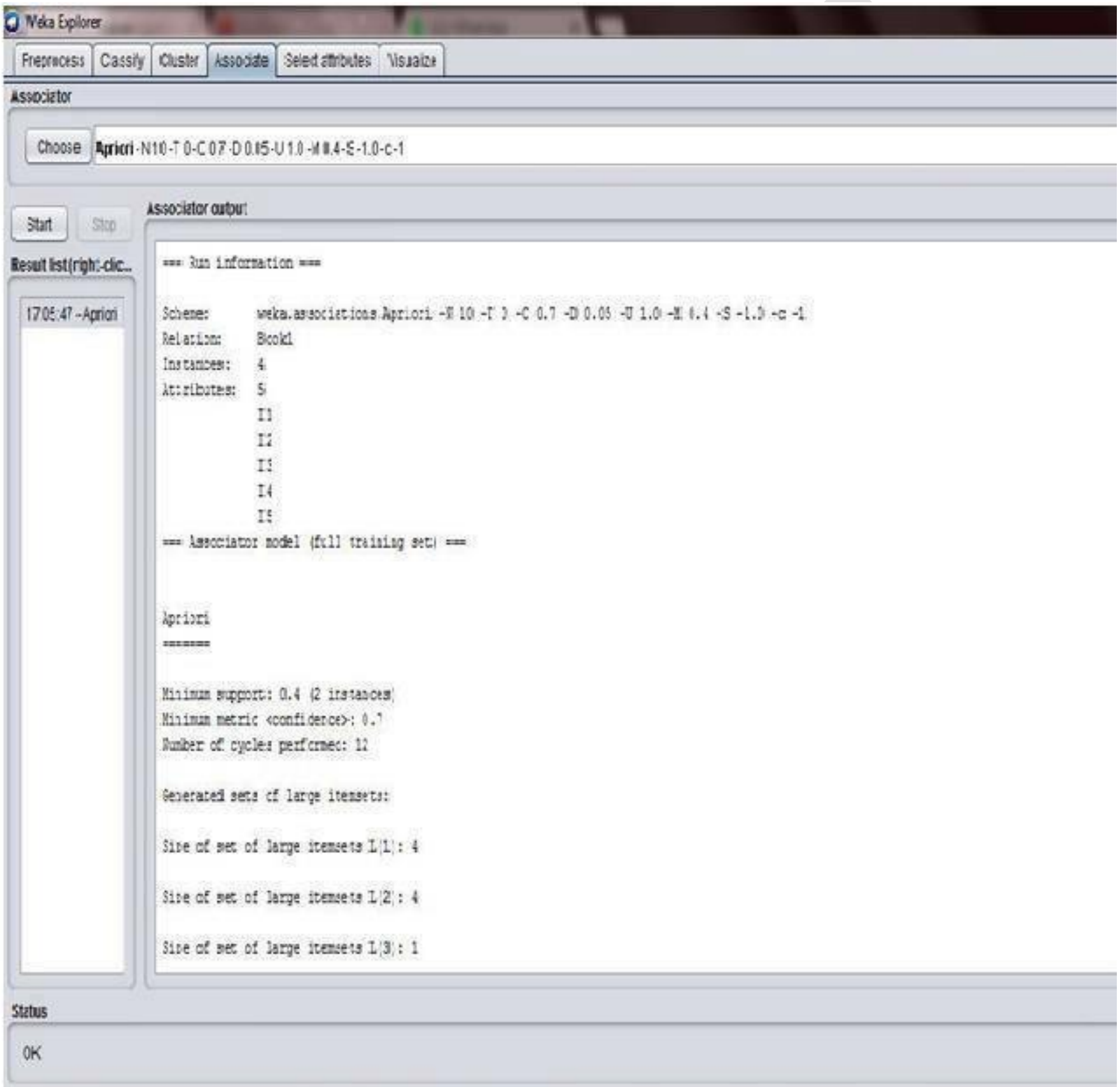
Now select the association tab and then choose apriori algorithm by setting the minimumsupport and confidence as shown in the figure

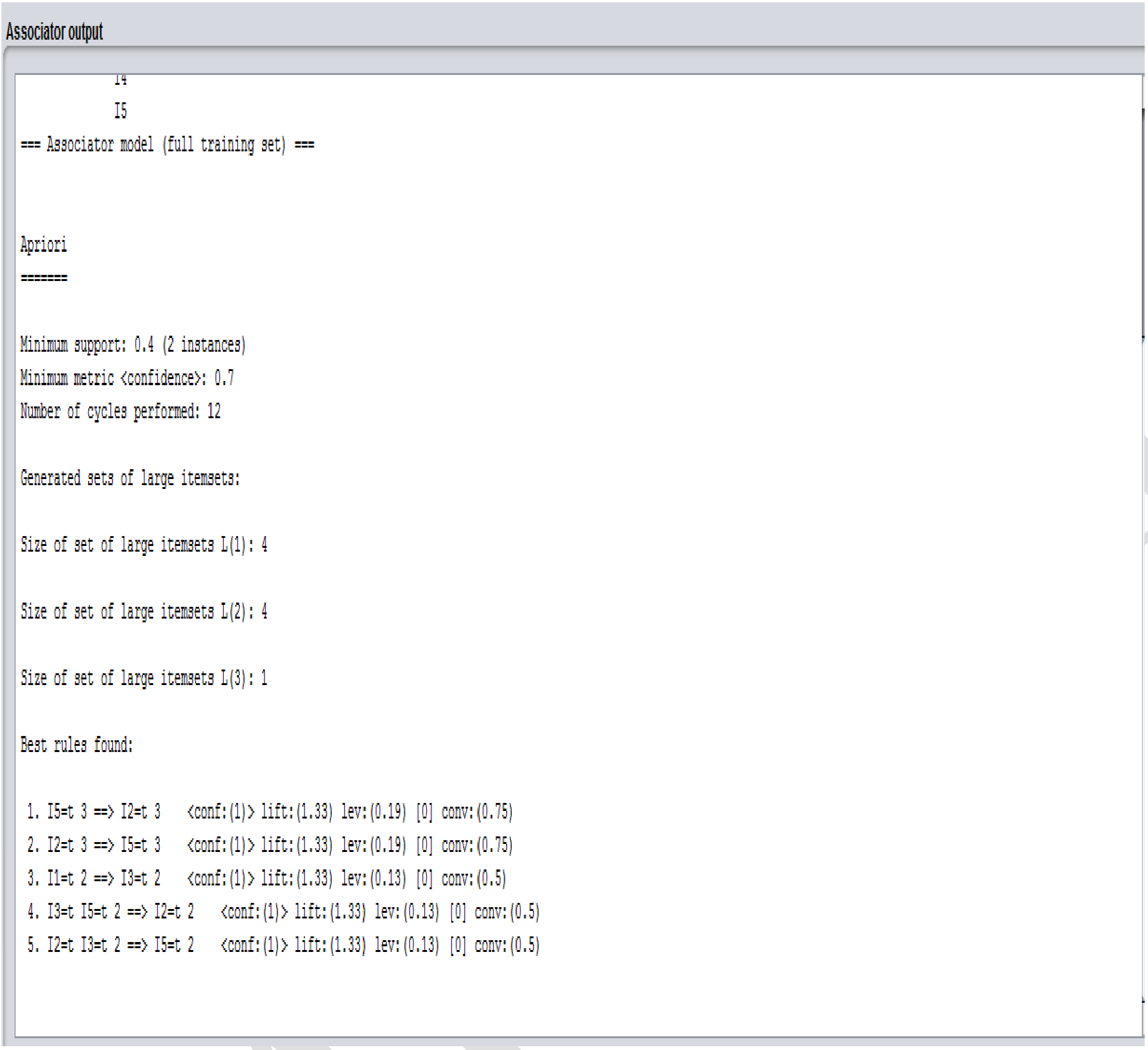


Step 3:

Now run the apriori algorithm with the set values of minimum support and the confidence. After running the weka generates the association rules and the respective confidence with minimum support as shown in the figure.

The above csv file has generated 5 rules as shown in the figure:





```
Associator output
            I4
            I5
=== Associator model (full training set) ===


Apriori
=======

Minimum support: 0.4 (2 instances)
Minimum metric <confidence>: 0.7
Number of cycles performed: 12

Generated sets of large itemsets:

Size of set of large itemsets L(1): 4

Size of set of large itemsets L(2): 4

Size of set of large itemsets L(3): 1

Best rules found:

 1. I5=t 3 ==> I2=t 3    <conf:(1)> lift:(1.33) lev:(0.19) [0] conv:(0.75)
 2. I2=t 3 ==> I5=t 3    <conf:(1)> lift:(1.33) lev:(0.19) [0] conv:(0.75)
 3. I1=t 2 ==> I3=t 2    <conf:(1)> lift:(1.33) lev:(0.13) [0] conv:(0.5)
 4. I3=t I5=t 2 ==> I2=t 2    <conf:(1)> lift:(1.33) lev:(0.13) [0] conv:(0.5)
 5. I2=t I3=t 2 ==> I5=t 2    <conf:(1)> lift:(1.33) lev:(0.13) [0] conv:(0.5)
```

Conclusion:
As we have seen the total rules generated by us manually and by the weka are matching, hence the rules generated are 5.

Exercise:

1.Apply the Apriori algorithm on Airport noise monitoring dataset discriminating between patients with parkinsons and neurological diseases using voice recording dataset. [https://archive.ics.uci.edu/ml/machine-learning-databases/00000/ refer this link for datasets]

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Experiment 6: Implementation of FP- Growth Algorithm

(6a) Aim: To generate association rules using FP Growth Algorithm

PROBLEM:
To find all frequent item sets in following dataset using FP-growth algorithm. Minimum support=2 and confidence =70%

TID	ITEMS
100	1,3,4
200	2,3,5
300	1,2,3,5
400	2,5

Solution:
Similar to Apriori Algorithm, find the frequency of occurrences of all each item in dataset and then prioritize the items according to its descending order of its frequency of occurrence. Eliminating those occurrences with the value less than minimum support and assigning the priorities, we obtain the following table.

ITEM	NO. OF TRANSACTIONS	PRIORITY
1	2	4
2	3	1
3	3	2
5	3	3

Re-arranging the original table, we obtain

TID	ITEMS
100	1,3
200	2,3,5
300	2,3,5,1
400	2,5

Construction of tree:
Note that all FP trees have „null" node as the root node. So, draw the root node first and attach the items of the row 1 one by one respectively and write their occurrences in front of it. The tree is further expanded by adding nodes according to the prefixes (count) formed and by further incrementing the occurrences every time they occur and hence the tree is built.

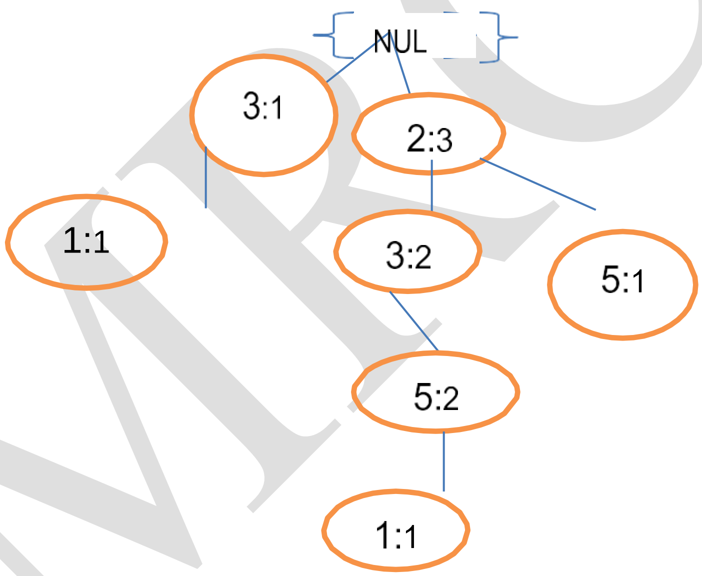
Prefixes:

- 1->3:1 2,3,5:1
- 5->2,3:2 2:1
- 3->2:2

Frequent item sets:

- 1-> 3:2 /*2 and 5 are eliminated because they"re less than minimum support, and the occurrence of 3 is obtained by adding the occurrences in both the instances*/
- Similarly, 5->2,3:2 ; 2:3;3:2
- 3->2 :2

Therefore, the frequent item sets are {3,1}, {2,3,5}, {2,5}, {2,3},{3,5}
The tree is constructed as below:



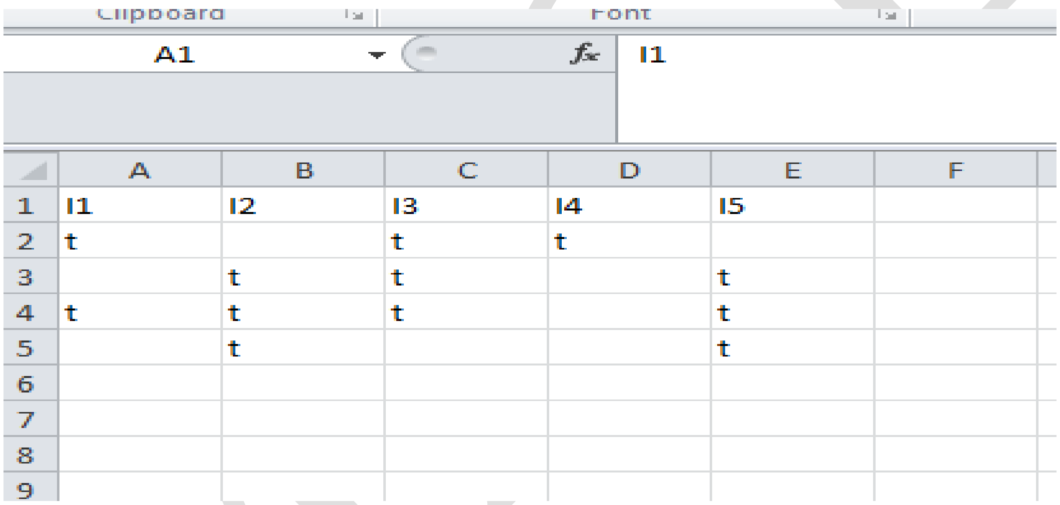
Generating the association rules for the following tree and calculating the confidence measures we get-

- {3}=>{1}=2/3=67%
- {1}=>{3}=2/2=100%
- {2}=>{3,5}=2/3=67%

- {2,5}=>{3}=2/3=67%
- {3,5}=>{2}=2/2=100%
- {2,3}=>{5}=2/2=100%
- {3}=>{2,5}=2/3=67%
- {5}=>{2,3}=2/3=67%
- {2}=>{5}=3/3=100%
- {5}=>{2}=3/3=100%
- {2}=>{3}=2/3=67%
- {3}=>{2}=2/3=67%

Thus eliminating all the sets having confidence less than 70%, we obtain the following conclusions:
{1}=>{3} , {3,5}=>{2} , {2,3}=>{5} , {2}=>{5}, {5}=>{2}.

As we see there are 5 rules that are being generated manually and these are to be checked against the results in WEKA. Inorder to check the results in the tool we need to follow the similar procedure like
Apriori.



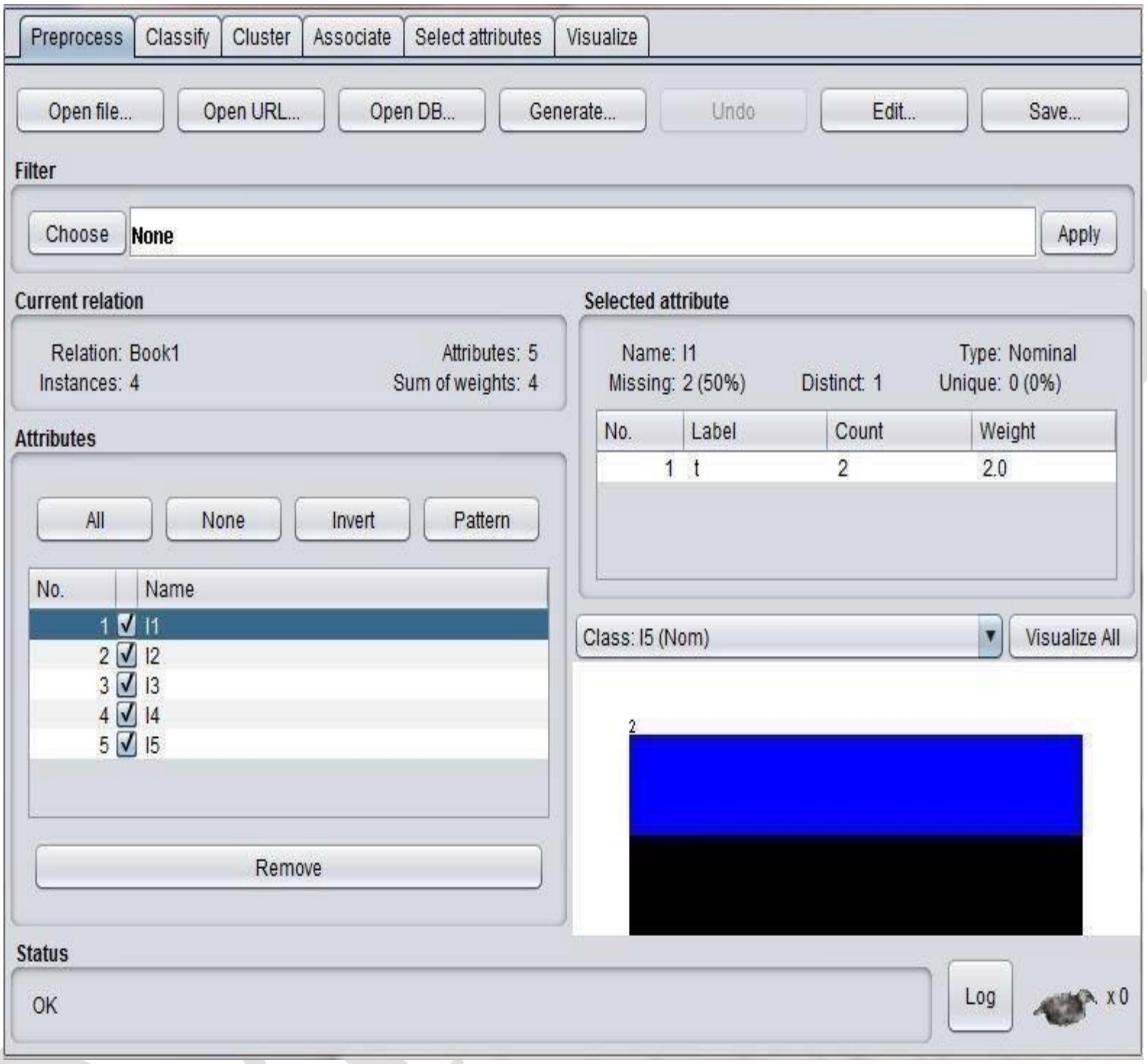
	A	B	C	D	E	F
1	I1	I2	I3	I4	I5	
2	t		t	t		
3		t	t		t	
4	t	t	t		t	
5		t			t	
6						
7						
8						
9						

Sofirst create a csv file forthe above problem, the csv file for the above problem will look like the rows and columns in the above figure. This file is written in excel sheet.

Procedure for running the rules in weka:

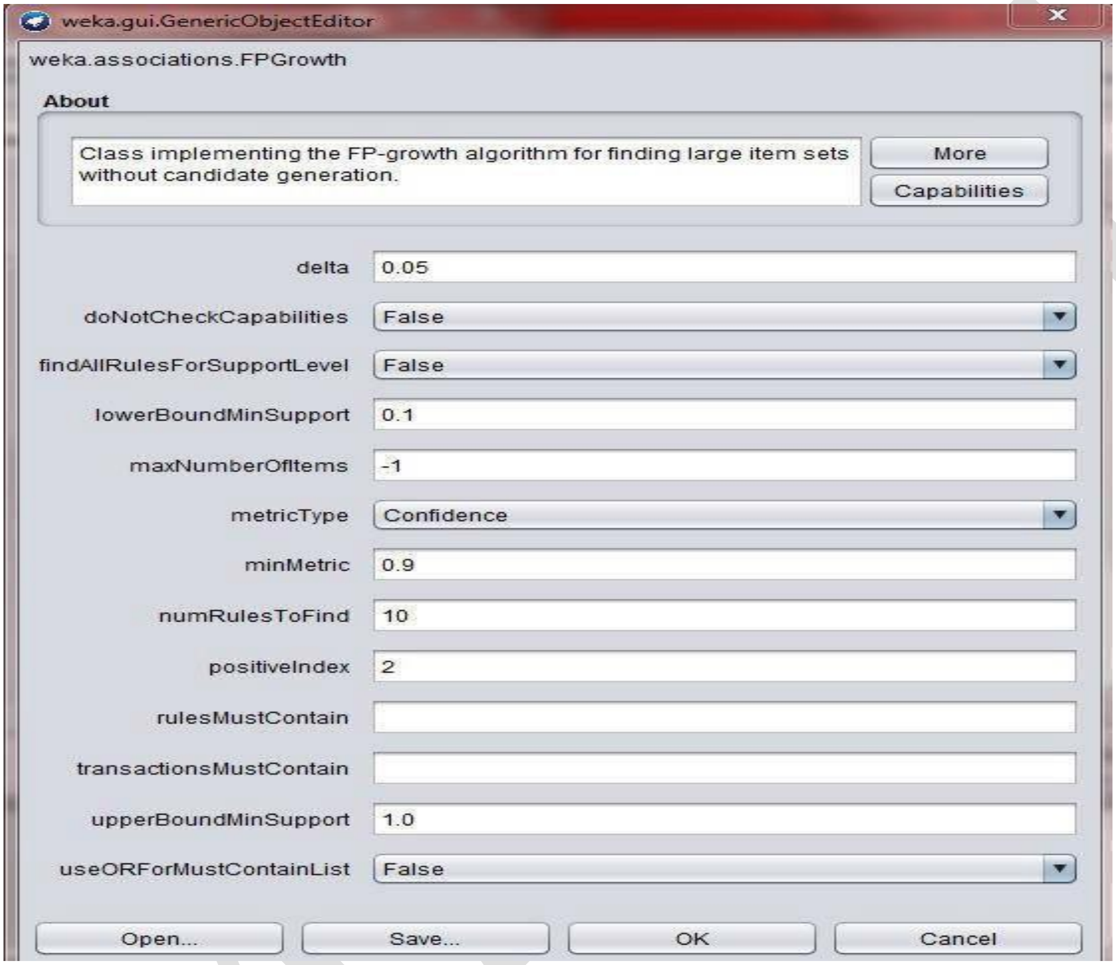
Step 1:

Open weka explorer and open the file and then select all the item sets. The figure gives a better understanding of how to do that.



Step 2:

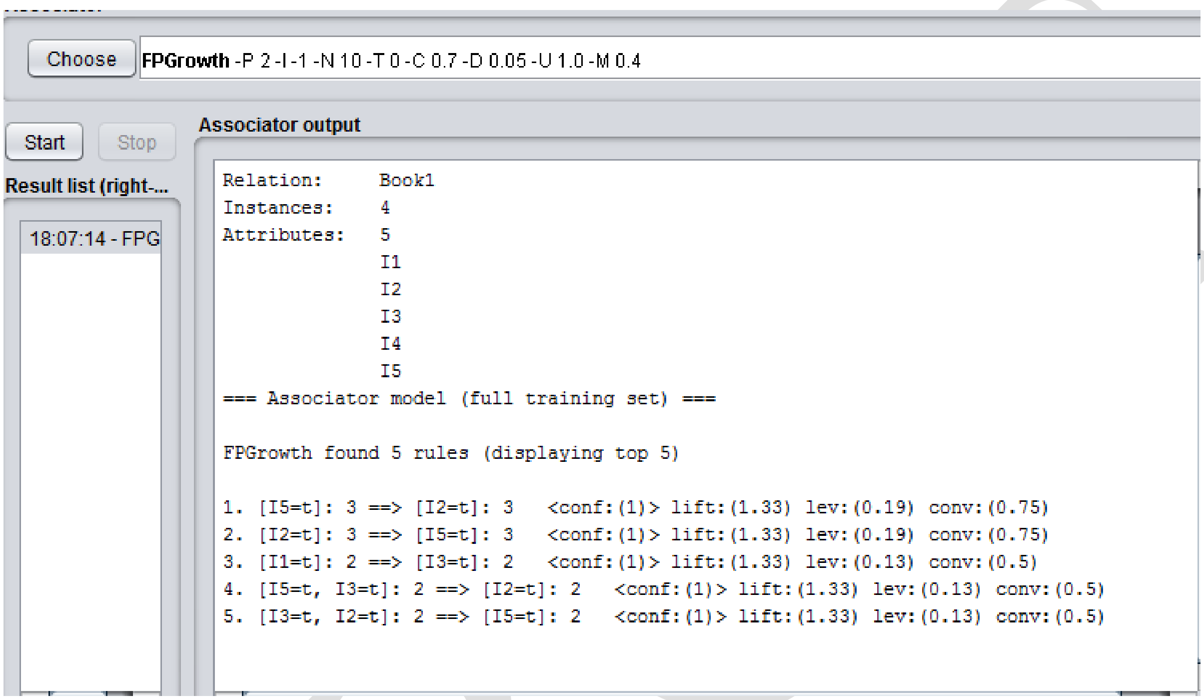
Now select the association tab and then choose FP growth algorithm by setting the minimum support and confidence as shown in the figure.



Step 3:

Now run the FP Growth algorithm with the set values of minimum support and the confidence. After running the weka generates the association rules and the respective confidence with minimum support as shown in the figure.

The above csv file has generated 5 rules as shown in the figure:



Conclusion:

As we have seen the total rules generated by us manually and by the weka are matching, hence the rules generated are 5.

Exercise

1. Apply FP-Growth algorithm on Blood Transfusion Service Center data set

Record Notes

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Experiment 7: Decision Tree Induction

Aim: Generate a Decision Tree by using J48 algorithm.

DESCRIPTION:

Decision tree learning is one of the most widely used and practical methods for inductive inference over supervised data. It represents a procedure for classifying categorical database on their attributes. This representation of acquired knowledge in tree form is intuitive and easy to assimilate by humans.

ILLUSTRATION:

Build a decision tree for the following data

AGE	INCOM E	STUDENT	CREDIT_RATING	BUYS_COMPUTER
Youth	High	No	Fair	No
Youth	High	No	Excellent	No
Middle aged	High	No	Fair	Yes
Senior	Medium	No	Fair	Yes
Senior	Low	Yes	Fair	Yes
Senior	Low	Yes	Excellent	No
Middle aged	Medium	Yes	Excellent	Yes
Youth	Low	No	Fair	No
Youth	Medium	Yes	Fair	Yes
Senior	Medium	Yes	Fair	Yes
Youth	Medium	Yes	Excellent	Yes
Middle aged	Medium	No	Excellent	Yes
Middle aged	High	Yes	Fair	Yes
Senior	Medium	No	Excellent	No

The entropy is a measure of the uncertainty associated with a random variable. As uncertainty increases, so does entropy, values range from [0-1] to present the entropy of information

Entropy (D) = $\sum_{j=1}^{c} -p \log_2 p$

Information gain is used as an attribute selection measure; pick the attribute having the highest information gain, the gain is calculated by:

Gain (D, A) = Entropy (D) - $\sum_{j=1}^{c} (|Dj|/|D|) Entropy(D)$

Where, D: A given data partition A: Attribute

V: Suppose we were partition the tuples in D on some attribute A having v distinct values D is split into v partition or subsets, (D1, D2….. Dj) , where Dj contains those tuples in D that have outcome Aj of A.

Class P: buys_computer="yes"
Class N: buys_computer="no"

Entropy (D) = -9/14log (9/14)-5/15log (5/14) =0.940

Compute the expected information requirement for each attribute start with the attribute age Gain (age, D)

= Entropy (D) - $\sum_{youth,middle-aged,senior}^{...} \left(\frac{Sv}{S}\right) \text{Entropy}(Sv)$

= Entropy (D) – 5/14Entropy(Syouth)-4/14Entropy(Smiddle-aged)-5/14Entropy(Ssenior)
= 0.940-0.694
=0.246

Similarly, for other attributes,
Gain (Income, D) =0.029
Gain (Student, D) = 0.151
Gain (credit_rating, D) = 0.048

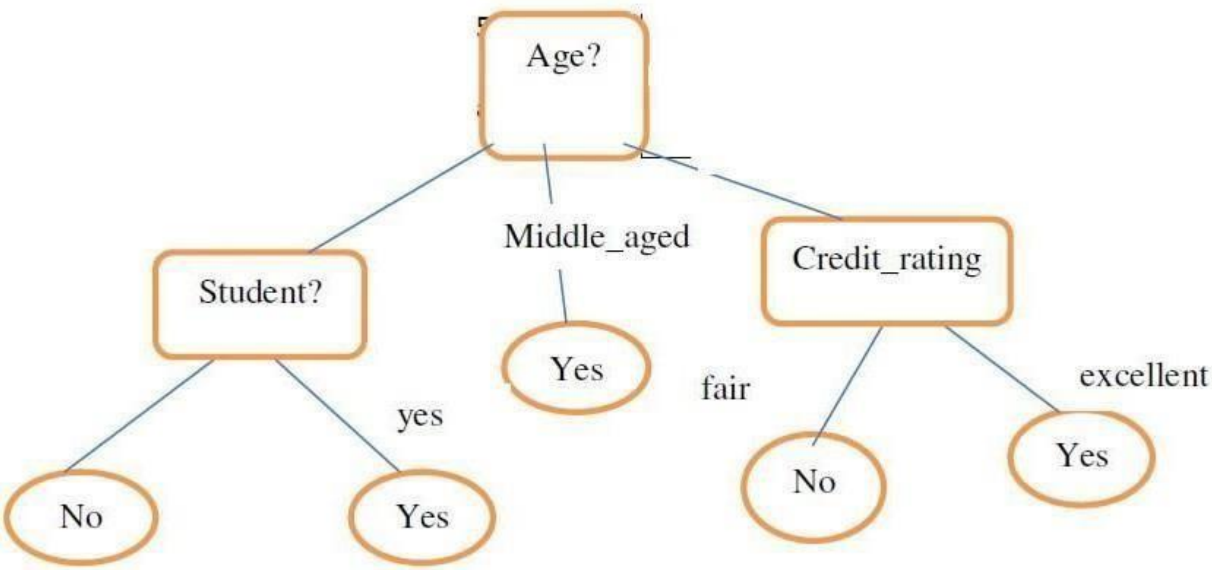
Income	Student	Credit_rating	Class
High	No	Fair	No
High	No	Excellent	No
Medium	No	Fair	No
Low	Yes	Fair	Yes
medium	Yes	excellent	yes

Now, calculating information gain for subtable (age<=30)

I The attribute age has the highest information gain and therefore becomes the splitting
* attribute at the root node of the decision tree. Branches are grown for each outcome of age. These tuples are shown partitioned accordingly.

Income=”high” S11=0, S12=2
I=0
Income=”medium” S21=1 S22=1
I (S21, S23) = 1
Income=”low” S31=1 S32=0
I=0
Entropy for income
E(income) = (2/5)(0) + (2/5)(1) + (1/5)(0) = 0.4
Gain(income) = 0.971 - 0.4 = 0.571

Similarly, Gain(student)=0.971
Gain(credit)=0.0208
Gain(student) is highest ,



A decision tree for the concept buys_computer, indicating whether a customer at All Electronics is likely to purchase a computer. Each internal (non-leaf) node represents a test on an attribute. Each leaf node represents a class (either buys_computer=”yes” or buys_computer=”no”.

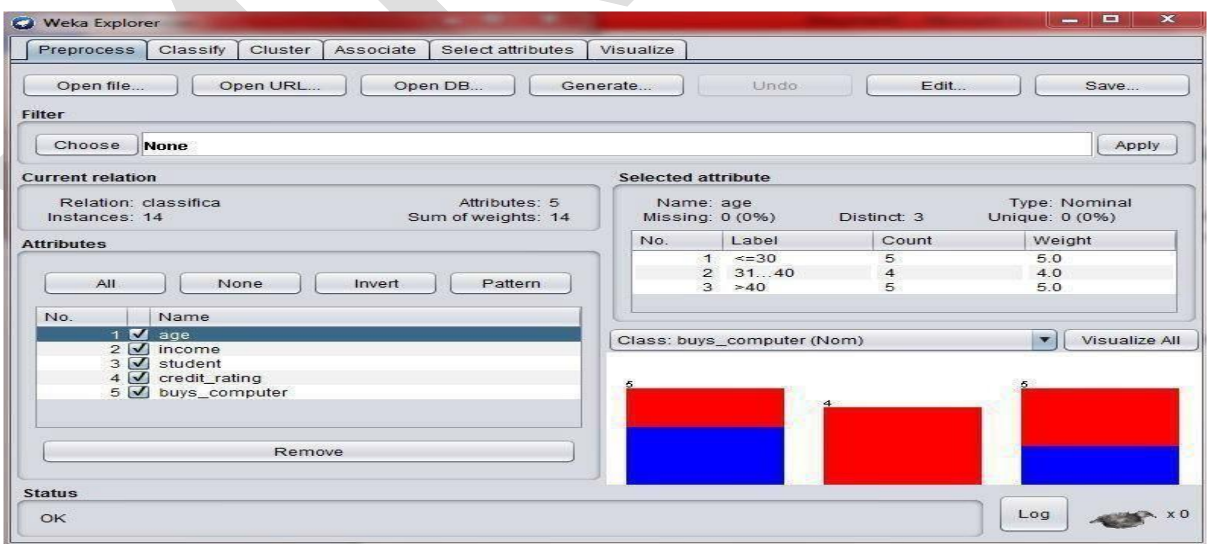
first create a csv file for the above problem,the csv file for the above problem will look like the rows and columns in the above figure. This file is written in excel sheet.

	A	B	C	D	E	F
1	age	income	student	credit_rat	buys_computer	
2	<=30	high	no	fair	no	
3	<=30	high	no	excellent	no	
4	31...40	high	no	fair	yes	
5	>40	medium	no	fair	yes	
6	>40	low	yes	fair	yes	
7	>40	low	yes	excellent	no	
8	31...40	low	yes	excellent	yes	
9	<=30	medium	no	fair	no	
10	<=30	low	yes	fair	yes	
11	>40	medium	yes	fair	yes	
12	<=30	medium	yes	excellent	yes	
13	31...40	medium	no	excellent	yes	
14	31...40	high	yes	fair	yes	
15	>40	medium	no	excellent	no	
16						

Procedure for running the rules in weka:

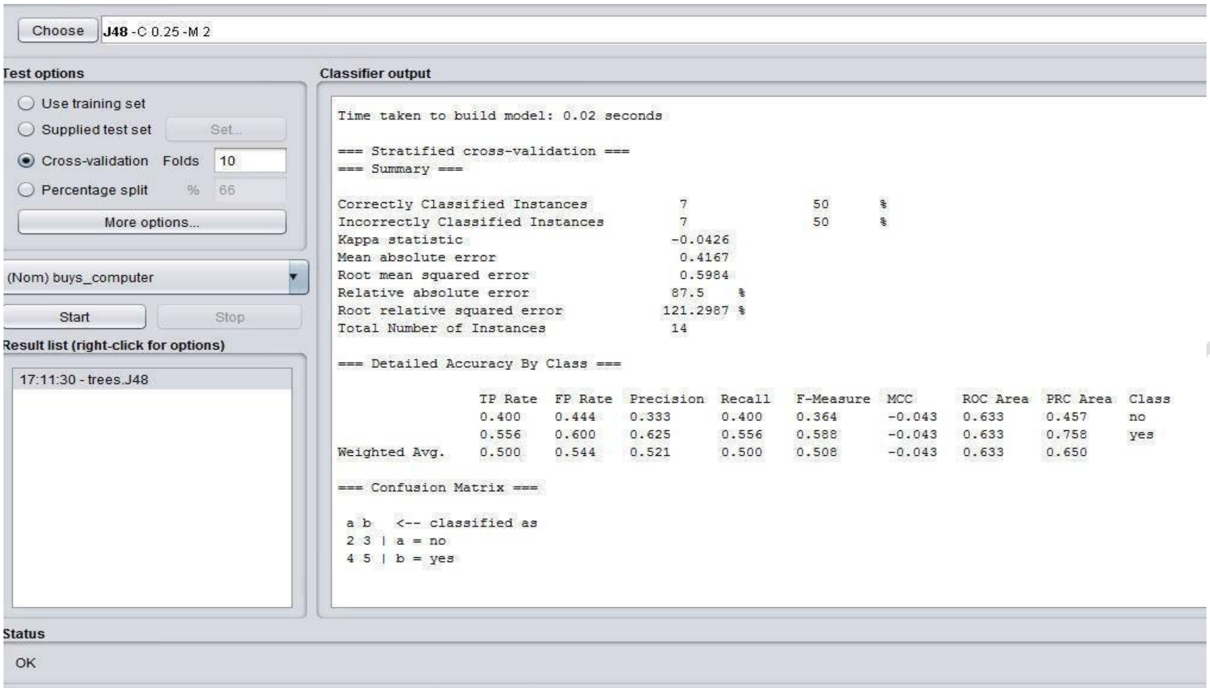
Step 1:

Open weka explorer and open the file and then select all the item sets. The figure gives a better understanding of how to do that.



Step2:

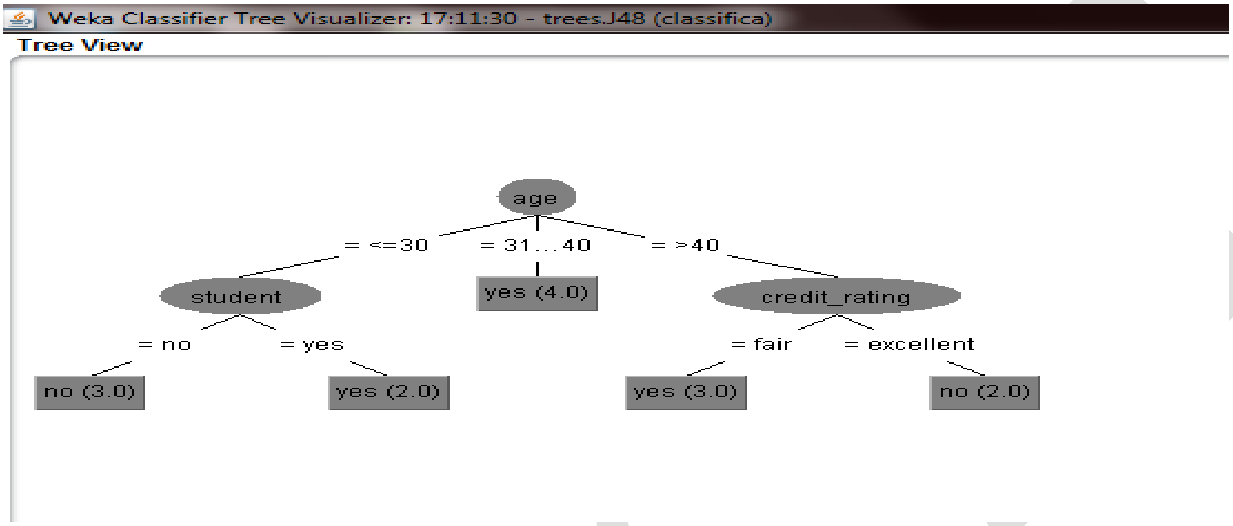
Now select the classify tab in the tool and click on start button and then we can see the result of the problem as below



Step3:

Check the main result which we got manually and the result in weka by right clicking on the result and visualizing the tree.

The visualized tree in weka is as shown below:



Conclusion:
The solution what we got manually and the weka both are same.

Exercise:

1. Apply decision tree algorithm to book a table in a hotel/ book a train ticket/ movie ticket.

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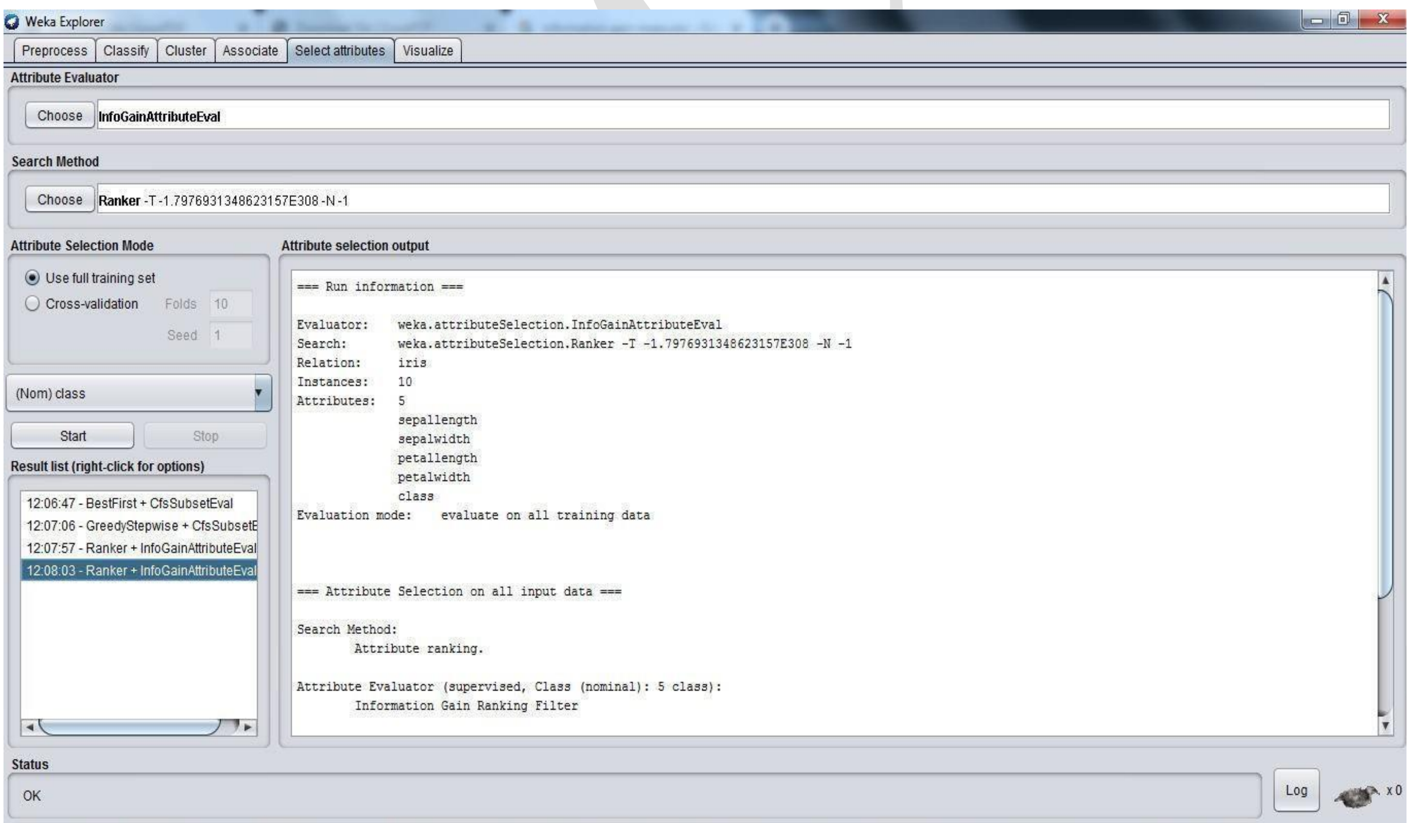
Experiment 8: Calculating information gain measures.

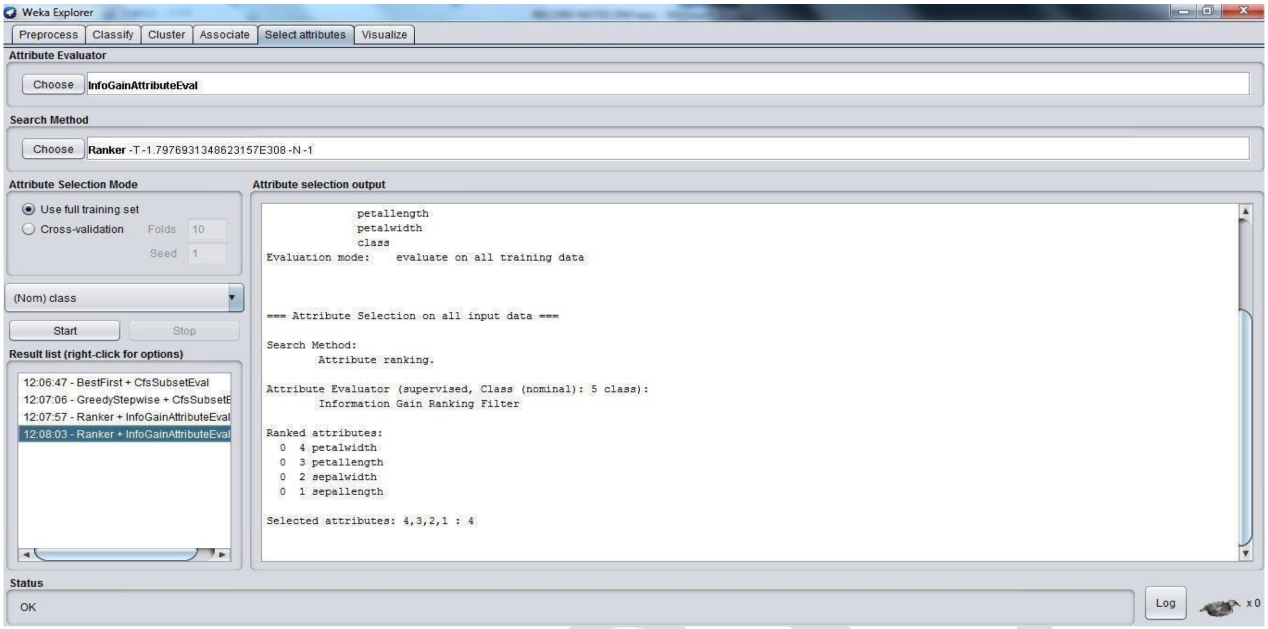
Information gain (IG) measures how much "information" a feature gives us about the class. – Features that perfectly partition should give maximal information. – Unrelated features should give no information. It measures the reduction in entropy. CfsSubsetEval aims to identify a subset of attributes that are highly correlated with the target while not being strongly correlated with one another. It searches through the space of possible attribute subsets for the "best" one using the BestFirst search method by default, although other methods can be chosen. To use the wrapper method rather than a filter method, such as CfsSubsetEval, first select WrapperSubsetEval and then configure it by choosing a learning algorithm to apply and setting the number of cross-validation folds to use when evaluating it on each attribute subset.

Steps:

- Open WEKA Tool.
- Click on WEKA Explorer.
- Click on Preprocessing tab button.
- Click on open file button.
- Select and Click on data option button.
- Choose a data set and open file.
- Click on select attribute tab and Choose attribute evaluator, search method algorithm



- Click on start button.



Exercise

Calculate the information gain on weather data set(for each attributes separately).

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Experiment 9: Classification of data using Bayesian approach

AIM: To apply naïve bayes classifier on a given data set.

Description:
In machine learning, Naïve Bayes classifiers are a family of simple probabilistic classifiers based on applying Bayes‟ Theorem with strong (naïve) independence assumptions between the features

Example:
.

AGE	INCOME	STUDENT	CREDIT_RATING	BUYS_COMPUTER
<30	High	No	Fair	No
<30	High	No	Excellent	No
31-40	High	No	Fair	Yes
>40	Mediu m	No	Fair	Yes
>40	Low	Yes	Fair	Yes
>40	Low	Yes	Excellent	No
31-40	Mediu m	Yes	Excellent	Yes
<=30	Low	No	Fair	No
<=30	Mediu m	Yes	Fair	Yes
>40	Mediu m	Yes	Fair	Yes
<30	Mediu m	Yes	Excellent	Yes
31-40	Mediu m	No	Excellent	Yes
31-40	High	Yes	Fair	Yes
>40	Mediu m	No	Excellent	No

CLASS:
C1:buys_com
puter = 'yes'
C2:buys_com
puter='no'
DATA TO
BECLASSIFIED
:

X= (age<=30, income=Medium, Student=Yes, credit_rating=Fair)

- P(C1): P(buys_computer="yes")= 9/14 =0.643
  P (buys_computer="no") =5/14=0.357

- Compute P(X/C1) and p(x/c2) weget:

1. P(age="<=30" |buys_computer="yes")=2/9
2. P(age="<=30"|buys_computer="no")=3/5
3. P(income="medium"|buys_computer="yes")=4/9
4. P(income="medium"|buys_computer="no")=2/5
5. P(student="yes"|buys_computer="yes")=6/9
6. P(student="yes" |buys_computer="no")=1/5=0.2
7. P(credit_rating="fair "|buys_computer="yes")=6/9
8. P(credit_rating="fair" |buys_computer="no")=2/5

- X=(age<=30, income=medium, student=yes, credit_rating=fair) P(X/C1): P (X/buys_computer="yes")=2/9*4/9*6/9*6/9= 32/1134
  P(X/C2):P(X/buys_computer="no")=3/5*2/5*1 /5*2/5=12/125

  P(C1/X)=P(X/C1)*P(C1)

  P(X/buys_computer="yes")*P(buys_computer="yes")=(32/1134)*(9/14)=0.019

  P(C2/X)=p(x/c2)*p(c2)

  P (X/buys_computer="no")*P(buys_computer="no")=(12/125)*(5/14)=0.007

  Therefore, conclusion is that the given data belongs to C1 since P(C1/X)>P(C2/X)

Checking the result in the WEKA tool:

In order to check the result in the tool we need to follow a procedure.

Step:1

Create a csv file with the above table considered in the example. the arfffile will look as shown below:

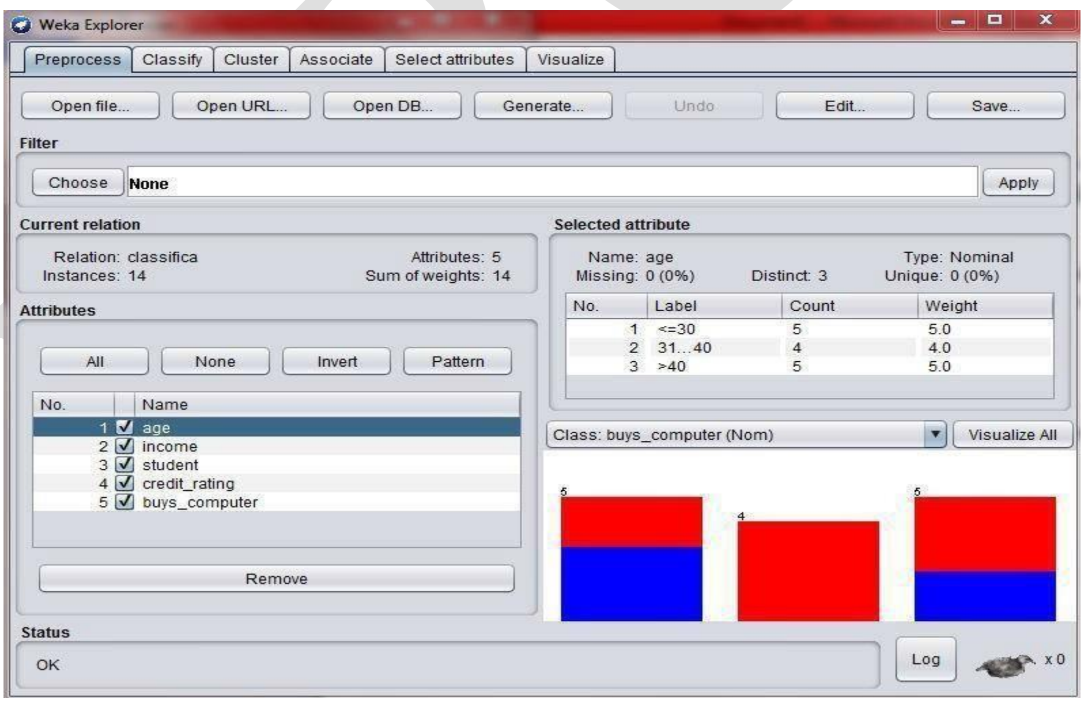
```
@relation store

@attribute age {young, middle-aged, old}
@attribute income {high,medium,low}
@attribute student {yes,no}
@attribute credit-rating {fair,excellent}
@attribute buys-computer {yes,no}

@data
young,high,no,fair,no
young,high,no,excellent,no
middle-aged,high,no,fair,yes
old,medium,no,fair,yes
old,low,yes,fair,yes
old,low,yes,excellent,no
middle-aged,low,yes,excellent,yes
young,medium,no,fair,no
young,low,yes,fair,yes
old,medium,yes,fair,yes
young,medium,yes,excellent,yes
middle-aged,medium,no,excellent,yes
middle-aged,high,yes,fair,yes
old,medium,no,excellent,no
```

Step2:

Now open weka explorer and then select all the attributes in the table.



Step 3:

Select the classifier tab in the tool and choose baye‟s folder and then naïve baye‟s classifier to see the result as shown below.

```
Classifier output
=== Evaluation on test set ===

Time taken to test model on supplied test set: 0.01 seconds

=== Summary ===

Correctly Classified Instances           0                0      %
Incorrectly Classified Instances         1              100      %
Kappa statistic                          0
Mean absolute error                      0.7538
Root mean squared error                  0.7538
Relative absolute error                120.6124 %
Root relative squared error            120.6124 %
Total Number of Instances                1

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.000    1.000    0.000      0.000    0.000      0.000    ?         ?         yes
                 0.000    0.000    0.000      0.000    0.000      0.000    ?         1.000     no
Weighted Avg.    0.000    0.000    0.000      0.000    0.000      0.000    0.000     1.000

=== Confusion Matrix ===

 a b   <-- classified as
 0 0 | a = yes
 1 0 | b = no
```

Exercise

1. Classify data (lung cancer/ diabetes /liver disorder) using Bayesian approach .

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Experiment 10: Implementation of K-means algorithm

DESCRIPTION:

K-means algorithm aims to partition n observations into “k clusters” in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in partitioning of the data into Voronoi cells.

ILLUSTRATION:

As a simple illustration of a k-means algorithm, consider the following data set consisting of the scores of two variables on each of the five variables.

I	X1	X2
A	1	1
B	1	0
C	0	2
D	2	4
E	3	5

This data set is to be grouped into two clusters: As a first step in finding a sensible partition, let the A & C values of the two individuals furthest apart (using the Euclidean distance measure), define the initial cluster means, giving:

Cluster	Individual	Mean Vector(Centroid)
Cluster1	A	(1,1)
Cluster2	C	(0,2)

The remaining individuals are now examined in sequence and allocated to the cluster to which they are closest, in terms of Euclidean distance to the cluster mean. The mean vector is recalculated each time a new member is added. This leads to the following series of steps:

	A	C
A	0	1.4
B	1	2.5
C	1.4	0
D	3.2	2.82
E	4.5	4.2

Initial partitions have changed, and the two clusters at this stage having the following characteristics.

	Individual	Mean vector(Centroid)
Cluster 1	A,B	(1,0.5)
Cluster 2	C,D,E	(1.7,3.7)

But we cannot yet be sure that each individual has been assigned to the right cluster. So, we compare each individual‟s distance to its own cluster mean and to that of the opposite cluster. And, we find:

I	A	C
A	0.5	2.7
B	0.5	3.7
C	1.8	2.4
D	3.6	0.5
E	4.9	1.9

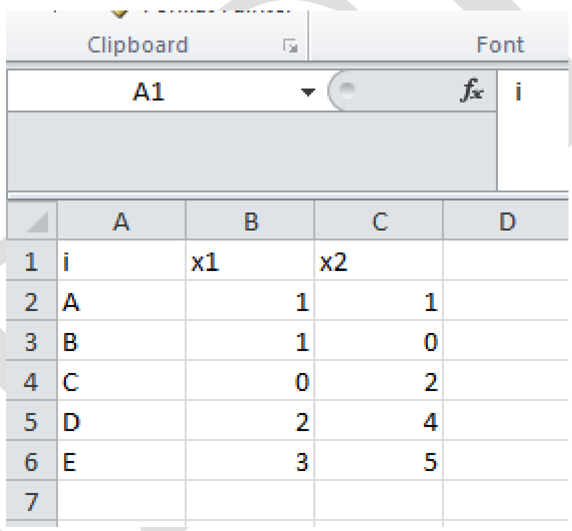
The individuals C is now relocated to Cluster 1 due to its less mean distance with the centroid points. Thus, its relocated to cluster 1 resulting in the new partition

	Individual	Mean vector(Centroid)
Cluster 1	A,B,C	(0.7,1)
Cluster 2	D,E	(2.5,4.5)

The iterative relocation would now continue from this new partition until no more relocation occurs. However, in this example each individual is now nearer its own cluster mean than that of the other cluster and the iteration stops, choosing the latest partitioning as the final cluster solution. Also, it is possible that the k-means algorithm won‟t find a final solution. In this case, it would be a better idea to consider stopping the algorithm after a pre-chosen maximum number of iterations.

<u>Checking the solution in weka:</u>
In order to check the result in the tool we need to follow a procedure.

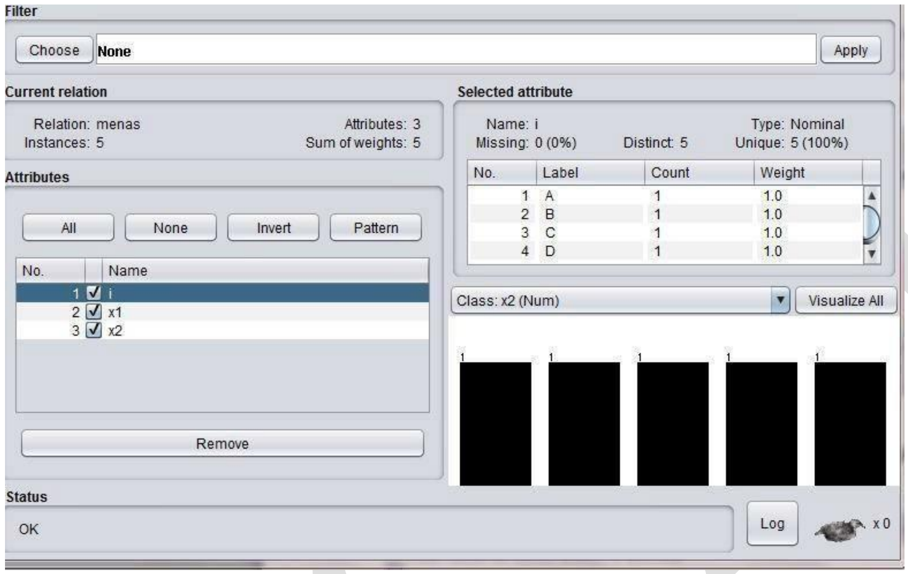
<u>Step 1:</u>
Create a csv file with the above table considered in the example. the csv file will look as shown below:



	A	B	C	D
1	i	x1	x2	
2	A	1	1	
3	B	1	0	
4	C	0	2	
5	D	2	4	
6	E	3	5	
7				

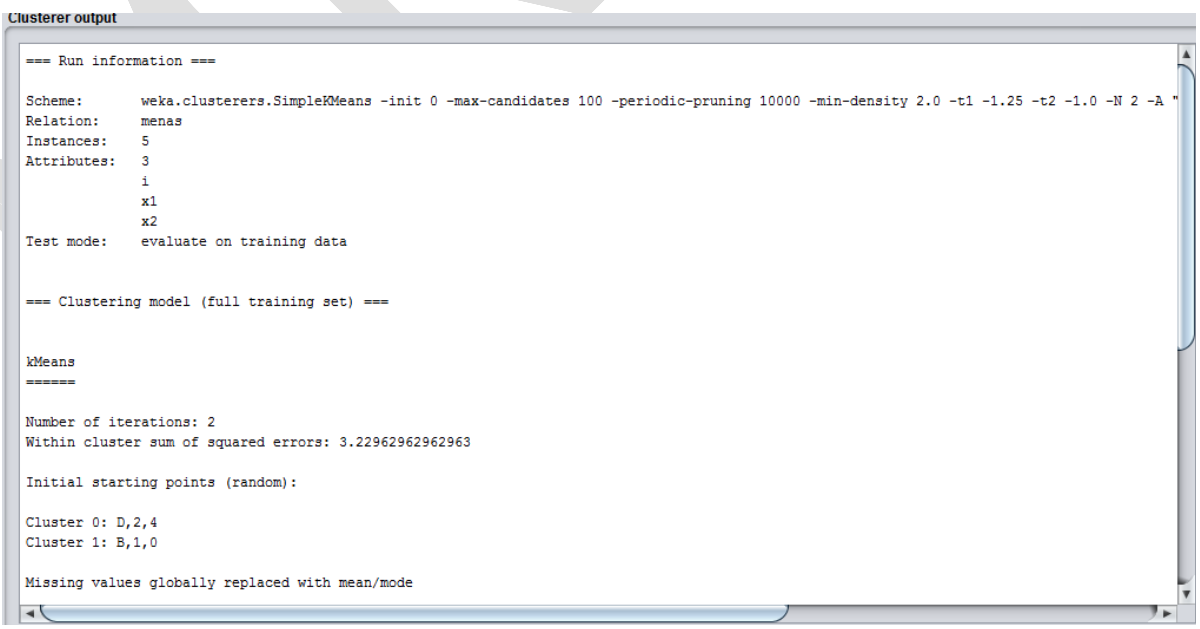
Step 2:

Now open weka explorer and then select all the attributes in the table.



Step 3:

Select the cluster tab in the tool and choose normal k-means technique to see the result as shown below.


Clusterer output

```
=== Run information ===

Scheme:       weka.clusterers.SimpleKMeans -init 0 -max-candidates 100 -periodic-pruning 10000 -min-density 2.0 -t1 -1.25 -t2 -1.0 -N 2 -A "
Relation:     menas
Instances:    5
Attributes:   3
              i
              x1
              x2
Test mode:    evaluate on training data


=== Clustering model (full training set) ===


kMeans
======

Number of iterations: 2
Within cluster sum of squared errors: 3.22962962962963

Initial starting points (random):

Cluster 0: D,2,4
Cluster 1: B,1,0

Missing values globally replaced with mean/mode
```

```
Final cluster centroids:
                          Cluster#
Attribute    Full Data           0           1
                 (5.0)       (2.0)       (3.0)
=============================================
i                    A           D           A
x1                 1.4         2.5      0.6667
x2                 2.4         4.5           1



Time taken to build model (full training data) : 0 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      2 ( 40%)
1      3 ( 60%)
```

Exercise

1. Implement of K-means clustering using crime dataset.

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Case Study

Create Placement.arff file to identify the students who are eligible for placements using KNN

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